

3.6 MONITORING AND RESEARCH PROGRAM

[*Note to Reviewers: This draft of the Monitoring and Research Program is revised from the July 27, 2009 draft. The two large monitoring actions tables included in this section are initial drafts that will be revised and refined. It is expected that a section will be added in future drafts, specifying in more detail the issues to be addressed by the research program and focus for additional research needs.*]

The BDCP Conservation Strategy provides flexibility for adjustments to be made over time as additional information becomes available about the ecological systems and processes of the Delta and the effect of the BDCP conservation measures on those systems and processes. Monitoring and research are critical elements of adaptive management, providing the data and analysis needed to inform decision-making. Information gained through monitoring and research also provides the basis for determining the effectiveness of the Conservation Strategy over time. A well-designed monitoring and research program is essential for the success of BDCP.

Monitoring will play four crucial roles in the implementation of the BDCP. First, it will provide basic information necessary to track Plan commitments and compliance with the terms and conditions of regulatory authorizations. Second, it will provide information about the current state of the system against which change can be assessed. Third, it will provide information about the changing state of the system as conservation actions are implemented that can be used to assess system response and progress toward achieving the Plan's goals and objectives over time. Finally, monitoring provides important information about implementation of conservation measures that can be used to increase their effectiveness.

Program evaluation involves compiling and synthesizing monitoring data to evaluate program success and support adjustments over time, including revising program objectives and actions. Program evaluation will also be used to support the Implementation Office's efforts to communicate information to the public about the status of the BDCP (Section 3.7, *Adaptive Management Program* discusses the program evaluation).

Information derived from research efforts will provide the basis for addressing key uncertainties and testing hypotheses that underpin various conservation measures. Research supports learning, a better understanding of the processes driving the system, and an improved knowledge base upon which informed decisions can be made regarding management interventions. Given the complexities of the Delta ecosystem, and the uncertainties regarding the outcomes that will result from the implementation of certain conservation measures, research and other information-gathering efforts will help ensure the success of the Plan.

This section describes key elements of the BDCP monitoring and research program, including: the parties responsible for implementing the monitoring program; the framework for integrating monitoring data to support program evaluation and reporting; the manner in which the BDCP monitoring program will interface with other monitoring programs; the types of monitoring that

1 will be conducted; the process that will be used to develop site-specific monitoring plans; and the
2 process that will be used to develop a research program. For more information on the Adaptive
3 Management Program, including the role of monitoring and research in the adaptive
4 management process, see Section 3.7, *Adaptive Management Program*.

5 Site-specific monitoring plans for each conservation measure, as well as a specific research
6 agenda, will be prepared as part of the BDCP implementation process. These plans will be
7 reviewed on a regular basis and adjustments made in response to new information and/or
8 identified research needs. Plan implementation, monitoring, analysis and research, are all part of
9 an overall adaptive management process. This process is not intended to be a stand-alone
10 process, but rather one that integrates information to facilitate decision making, including
11 decisions to adjust the design and implementation of conservation measures, and the type and
12 extent of monitoring associated with those measures, as the Plan is implemented.

13 Because the Delta reflects a highly altered ecosystem, with limited reference sites for historic
14 conditions, the monitoring program and the evaluation framework will rely heavily on
15 Before/After and Control/Impact (BACI) design approaches to assess ecosystem change (Green
16 1979, Underwood 1992, Underwood 1994). Although the BACI approach is typically presented
17 as a means for testing whether an impact to the system has occurred, it is technically a model that
18 tests for changes in conditions. The model may also be used to evaluate conservation and
19 restoration projects (Michener 1997 and Lincoln-Smith et al 2006) and test if conditions are
20 improving. These types of monitoring approaches are commonly used in restoration ecology,
21 particularly where numerous natural and anthropogenic disturbances represent unplanned,
22 uncontrollable events that cannot be replicated or studied using traditional experimental
23 approaches and statistical analyses. Ultimately, experience in restoration ecology suggests using
24 a broad mix of appropriate research approaches (e.g., long-term studies, large-scale comparative
25 studies, space-for-time substitution, modeling, manipulative experiments, and focused
26 experimentation) and analytical tools (e.g., observational, spatial, and temporal statistics)
27 (Michener 1997).

28 Evaluating discernable changes in environmental conditions is often difficult, due to the
29 multitude of interacting factors. It is often not clear which environmental component will be
30 affected by a stressor reduction and what type of change will result. A changing environment is
31 natural and variation due to natural effects may be great (Smith 2002). To account for this,
32 BDCP monitoring designs will be informed by the location and timing of effects expected to
33 occur (both spatially and temporally), what organisms are expected to be affected (fish, wildlife,
34 plants, aquatic invertebrates, etc.), what the expected benefits are (magnitude, duration),
35 potential mitigating factors (including distribution and exposure), and how various factors may
36 alter exposure and effect.

37 The BDCP monitoring program will be conducting sufficient baseline monitoring to establish the
38 “before” condition against which change can be compared. This will entail both assessing

1 existing data bases and determining what new measurements will be useful prior to the
2 implementation of a conservation measure.

3 The monitoring program outlined in this chapter is consistent with the guidance provided by the
4 U.S. Fish and Wildlife Service and the National Marine Fisheries Service in the “Five-Point
5 Policy” for Habitat Conservation Plans (HCP)¹ and provisions of the Natural Community
6 Conservation Planning Act (NCCPA)². As described in the Five-Point Policy, the monitoring
7 program of a conservation plan should generate information sufficient to guide plan
8 implementation, particularly with respect to the following matters:

9 *“(1) assess the implementation and effectiveness of the HCP terms and conditions (e.g.,*
10 *financial responsibilities and obligations, management responsibilities, and other aspects*
11 *of the incidental take permit, HCP, and the IA, if applicable); (2) determine the level of*
12 *incidental take of the covered species; (3) determine the biological conditions resulting*
13 *from the operating conservation program (e.g., change in the species’ status or a change*
14 *in the habitat conditions); and (4) provide any information needed to implement an*
15 *adaptive management strategy, if utilized. An effective monitoring program is flexible*
16 *enough to allow modifications, if necessary, to obtain the appropriate information.”³*

17 The BDCP research program will be implemented to address specific scientific questions
18 regarding: (1) covered species; (2) natural communities; and (3) ecosystem processes to increase
19 the base of knowledge about these resources such that conservation measures can be adaptively
20 implemented to advance biological goals and objectives. Specifically, the BDCP monitoring and
21 research program will be conducted primarily to:

- 22 • Document compliance with terms and conditions of BDCP regulatory authorizations,
23 including limits established for the incidental take of covered species;
- 24 • Increase and refine scientific understanding of the effects of the covered activities
25 (Chapter 4, *Covered Activities*) on covered species and natural communities;
- 26 • Collect data necessary to effectively implement conservation measures;
- 27 • Document and evaluate the effectiveness of conservation measures in achieving BDCP
28 biological goals and objectives;
- 29 • Test the scientific hypotheses on which the assessment of effects and effectiveness are
30 based; and
- 31 • Assess progress towards achieving the biological goals and objectives both specific to
32 conservation actions and Delta-wide.

¹65 FR 106, June 1, 2000

²Fish and Game Code Sections 2810(a)(7)

³65 FR 106, June 1, 2000; 35254

1 3.6.1 Responsibility for the Monitoring and Research Program

2 The Implementation Office (IO) Science Manager, under the direction of the BDCP Program
3 Manager, will be responsible for the overall management and oversight of the BDCP monitoring
4 and research programs, including the implementation of monitoring-related activities (see
5 Section 7.3.4, *Management of Biological Monitoring, Scientific Research, and Reporting*
6 *Programs*). The Science Manager, with the support of the Interagency Ecological Program
7 (IEP), will be responsible for developing and overseeing the implementation of the monitoring
8 and research program activities. The Science Manager may further utilize the Delta Science
9 Program and Independent Science Board to review and provide input on aspects of the
10 monitoring and research program. The IO may look to the Authorized Entities and Supporting
11 Entities (see Chapter 7, *Implementation Structure*) to conduct monitoring activities on specific
12 conservation actions, as appropriate.

13 The BDCP Science Manager will be responsible for ensuring that the BDCP science activities,
14 reporting, and reviews are coordinated with other science activities being conducted in the Delta.
15 The Science Manager will seek the assistance of the Lead Scientist of the IEP and the Chief
16 Scientist for the Delta Science Program to ensure that BDCP science activities, reporting, and
17 reviews are coordinated with other science activities being conducted in the Delta.

18 3.6.2 Monitoring Framework

19 The following outlines a framework for integrating monitoring data to support program
20 evaluation and reporting. The BDCP Evaluation Framework is described in Section 3.7, *Adaptive*
21 *Management Program*. Specific types of monitoring (baseline, compliance, effectiveness, and
22 system-wide) that will feed the evaluation framework (as well as other plan reporting
23 requirements) are described in more detail in Section 3.6.4, *Types of Monitoring*.

24 The BDCP monitoring framework as presented herein is modeled after the successful Ecosystem
25 Health Monitoring Program used as part of the Healthy Waterways Initiative in South East
26 Queensland, Australia (South East Queensland Healthy Waterways Partnership 2007). The
27 framework tracks indicators for five basic ecological conditions that collectively reflect the
28 overall health of the ecosystem. For the BDCP, the monitoring and evaluation framework is
29 divided into five ecological categories: (1) ecological processes; (2) physical and chemical
30 conditions (including nutrients); (3) food webs; (4) natural communities; and (5) fish, wildlife,
31 and plants, as illustrated in Figure 3-1 [*BDCP Monitoring and Evaluation Framework*]. A select
32 set of key indicators for these five characteristics will be measured for the appropriate
33 geographic area to assess status and trends. Specific indicators, metrics and sampling designs
34 will vary depending on the regional area.

35 Table 3-11 illustrates how the BDCP monitoring and evaluation framework could be structured.
36 An example of all likely possible monitoring elements was developed for the implementation of
37 a project at Suisun Marsh under the CM4, *Tidal Habitat Restoration*. It is expected that

- 1 frameworks for other conservation measures will be developed and refined during plan
- 2 implementation using this as an example of the types of elements that could be included.
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Figure 3-1. BDCP Monitoring and Evaluation Framework



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Table 3-11. Example Framework For Southern Suisun Marsh Monitoring and Metrics

[Note to Reviewers: Table in development. To come]

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1 3.6.3 Integration of Monitoring and Research with Other Programs

2 Monitoring of covered species and many ecosystem conditions that are relevant to BDCP
3 implementation is currently undertaken by a number of entities, including IEP, Delta Science
4 Program, California State University Endangered Species Recovery Program, USGS, DFG,
5 DWR, USFWS, Reclamation, NOAA Fisheries Science Center, and UC Davis. As an example
6 of the types of monitoring data that are currently being collected, Table 3-12 lists some of the
7 fisheries monitoring data that is coordinated by the IEP.⁴

8 In addition to fish monitoring, there is a considerable amount of water quality monitoring that is
9 currently being conducted in the Delta. The Environmental Monitoring Program (which also
10 monitors lower trophic levels) is part of the IEP, while programs tracking environmental
11 contaminants currently are not. The new Delta Regional Monitoring Program is intended to
12 coordinate these programs.^{5 6}

13 Most of the existing Delta monitoring efforts are being implemented as conditions of existing
14 regulatory authorizations and many are coordinated under the IEP umbrella. The IEP has been
15 instrumental in coordinating Delta monitoring and research activities conducted by State and
16 federal agencies and other science partners for 40 years. IEP monitoring activities are generally
17 carried out in compliance with Water Right Decision and Endangered Species Act permit
18 conditions. Most of the existing IEP-coordinated monitoring focuses on open water areas and
19 the major Delta waterways conveying water to the SWP and CVP facilities in the south Delta. A
20 new regional monitoring program intended to coordinate Delta water quality monitoring in
21 compliance with Clean Water Act permit conditions is currently under development by the
22 Central Valley Regional Water Quality Control Board. A similar regional monitoring program
23 already exists for San Francisco Bay and is carried out by the San Francisco Estuary Institute, a
24 non-profit research organization.

25 Due to their permit-driven nature, none of the existing long-term monitoring programs focus
26 explicitly on monitoring ecological processes and habitats. Perhaps as a result, there has never
27 been an integrative “Ecosystem Health” assessment similar to the Australian example mentioned
28 in Section 3.6.2, Monitoring Framework. The “Are Our Aquatic Ecosystems Healthy?” portal⁷
29 currently under development by the California Water Quality Monitoring Council (WQMC) may
30 provide an opportunity to better organize, integrate, evaluate, and communicate data and
31 information about the health of the Delta relative to other aquatic ecosystems in California and
32 changes in Delta ecosystem health associated with the BDCP and other programs. The WQMC is
33 based on an interagency MOU mandated by California Senate Bill 1070 (Kehoe, 2006) and

⁴ A more complete summary of the IEP fish monitoring programs can be found at:

[Hhttp://www.water.ca.gov/iep/docs/IEP_FishMonitoring_final.pdf](http://www.water.ca.gov/iep/docs/IEP_FishMonitoring_final.pdf)H.

⁵ For information on this new Delta Regional Monitoring Program see

[Hhttp://www.swrcb.ca.gov/rwqcb5/water_issues/delta_water_quality/comprehensive_monitoring_program/index.shtml](http://www.swrcb.ca.gov/rwqcb5/water_issues/delta_water_quality/comprehensive_monitoring_program/index.shtml)H).

⁶ A recent summary of existing water quality monitoring programs can be found at

[Hhttp://www.swrcb.ca.gov/rwqcb5/water_issues/delta_water_quality/comprehensive_monitoring_program/draftfinal_deltamon_25nov09.pdf](http://www.swrcb.ca.gov/rwqcb5/water_issues/delta_water_quality/comprehensive_monitoring_program/draftfinal_deltamon_25nov09.pdf)H

⁷ See the portal at [Hhttp://www.waterboards.ca.gov/mywaterquality/](http://www.waterboards.ca.gov/mywaterquality/)

1 requires the boards, departments and offices within the California Environmental Protection
2 Agency (Cal/EPA) and the California Natural Resources Agency to integrate and coordinate
3 their water quality and related ecosystem monitoring, assessment, and reporting.

4 The Science Manager will coordinate with the IEP and other entities involved in monitoring
5 programs and will use data collected through these programs, as appropriate, to support
6 evaluation of the effectiveness of the BDCP Conservation Strategy in achieving biological goals
7 and objectives and to assess the long-term status and trends of covered species populations and
8 ecosystem conditions.

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Table 3-12. Sample Listing of Existing Bay-Delta Fish Monitoring Programs Coordinated through the Interagency Ecological Program (IEP)

<i>Monitoring Program</i>	<i>Agency</i>	<i>Primary Purpose</i>	<i>Available Data for BDCP</i>
Spring Kodiak trawl	DFG	Monitors spawning adult delta smelt distribution, relative abundance, and reproductive status, January-May, 2002-present	Spawning abundance index, distribution, sex ratios, reproductive status (e.g., pre-spawn, mature, or spent)
20 mm tow net survey	DFG	Monitors post larval-juvenile delta smelt distribution and relative abundance, March-June, 1995-present	Post larval and juvenile abundance index, distribution, length frequency
Summer tow net survey	DFG	Monitors striped bass and delta smelt abundance indices, July-August, 1959-present	Delta smelt: juvenile delta smelt abundance index, distribution, and length frequency. Long fin smelt: post larval juvenile long fin smelt abundance index, distribution, and length frequency. Sacramento split tail: YOY split tail, distribution, and length frequency
Fall midwinter trawl	DFG	Monitors striped bass and delta smelt abundance indices, September-December, 1967-present	Delta smelt: Pre-adult delta smelt abundance index. Long fin smelt: Pre-adult long fin smelt abundance index. Sacramento split tail: Abundance of all size classes
Smelt larval study	DFG	Monitors long fin smelt larvae distribution and relative abundance, January 2009-present	Larval abundance index and distribution
Bay Study	DFG	Monitors abundance indices for a variety of species in South San Francisco and Suisun Bays, Year-round, 1980-present	Delta smelt: Juveniles-adult delta smelt abundance index. Long fin smelt: Juveniles-adult long fin smelt abundance index. Sacramento split tail: Young of year and older split tail abundance.
Suisun Marsh fisheries monitoring program	UC Davis	Monitors abundance of all fish species in Suisun Marsh, Year-round, 1979-present	Delta smelt: Juveniles-adult delta smelt abundance, distribution within Suisun Marsh. Long fin smelt: Juveniles-adult long fin smelt abundance, distribution within Suisun Marsh. Sacramento split tail: Abundance of all size classes, distribution within Suisun Marsh.
Fish salvage monitoring	DWR, DFG, USBR	Monitors entrainment and salvage of all fish species, Year-round, 1979-present	Delta and long fin smelt: 20 mm post larvae-adult smelt abundance. Sacramento split tail: Abundance of all size classes >20 mm and length frequency. Almonds: >20 mm larvae-adults abundance. Sturgeon: >20 mm juvenile sturgeon abundance.
Chips Island, Moss dale, and Sacramento trawls	USFWS	Monitors fish abundance and distribution in mid-channel at surface at Chips Island, Moss dale (RM 54), and Sacramento (RM 55), and survival through the Delta, targets Chinook salmon, Year-round, 1976-present	Almonds: juvenile abundance, distribution, length frequency, survival indices (of hatchery tagged fish) to Chips Island Delta smelt: >25 mm abundance, distribution, and length frequency. Long fin smelt: >25 mm abundance and distribution, and length frequency. Sacramento split tail: >25 mm abundance and distribution, and length frequency.
Beach seines	USFWS	Monitors fish abundance and distribution throughout the Delta, upstream Sacramento River, northern San Francisco and San Pablo Bays, targets Chinook salmon, Year-round, 1976-present	Sacramento split tail: >25 mm young of year split tail abundance, distribution, and size frequency. Almonds: juvenile almonds, abundance, distribution, and size frequency.

Table 3-12. Sample Listing of Existing Bay-Delta Fish Monitoring Programs Coordinated through the Interagency Ecological Program (IEP) (continued)

<i>Monitoring Program</i>	<i>Agency</i>	<i>Primary Purpose</i>	<i>Available Data for BDCP</i>
Chinook salmon escapement estimates (Grand tab database)	DFG, DWR	Grand tab collects all races of Chinook salmon escapement	Almonds: adult returns to spawning grounds by race and location
Suisun March otter trawl	UC Davis	Monitors abundance of all fish species in Suisun Marsh, Year-round, 1979-present	Chinook salmon: juvenile abundance and distribution within Suisun Marsh
Adult sturgeon tagging study	DFG	Tag-recapture (via creel surveys) of green (prior to being listed) and white sturgeon for abundance and population dynamics	White and green sturgeon: abundance, distribution, population dynamics, length frequency, annual harvest rates, and migration rates.

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2 **3.6.4 Types of Monitoring**

3 The Implementation Office will conduct and/or coordinate several types of monitoring to ensure
4 the success of the Conservation Strategy. The general types of monitoring required are described
5 in this section.

6 **3.6.4.1 Preconstruction Surveys**

7 As specified in Section 3.4.4 *Avoidance and Minimization Measures*, preconstruction surveys are
8 required for specifically identified covered species, prior to the implementation of certain
9 covered activities and conservation measures (e.g., water facilities construction or tidal habitat
10 restoration actions that would remove existing terrestrial habitat) that may affect covered species
11 or their habitats.

12 The potentially affected area will be surveyed to determine if covered species are present and
13 likely to be affected by the activity. Survey results will be used by the Implementation Office to
14 determine the need to implement measures described in Section 3.4.4 to avoid and minimize
15 impacts on covered species and natural communities related to the covered activity or
16 conservation measure. Preconstruction surveys may also be used in measure and record the level
17 of take for a specific action as part of compliance monitoring, discussed below.

18 Preconstruction surveys may be coupled with baseline surveys, discussed below, as appropriate.

19 **3.6.4.2 Construction Monitoring**

20 Monitoring of construction activities will be conducted during the construction of various
21 proposed facilities (both covered activities and conservation measures), including habitat
22 restoration projects. Construction monitoring is required to ensure that avoidance and
23 minimization measures are properly carried out where specific sensitive occurrences of covered
24 species (e.g., an active nesting site for a covered bird species or a population of a highly
25 restricted covered plant species) have been identified at or adjacent to a construction site. The
26 Implementation Office will: (1) monitor implementation of covered activities to ensure that any
27 applicable avoidance and/or minimization measure is properly and effectively implemented, and

1 (2) ensure that conservation measures are implemented in accordance with specifications and
2 plans. Compliance Monitoring.

3 **3.6.4.3 Compliance Monitoring**

4 The purpose of compliance monitoring is to: (1) track progress of BDCP implementation in
5 accordance with established timetables, and (2) ensure compliance with terms and conditions of
6 the BDCP and its associated permits. Compliance monitoring will be undertaken for all
7 conservation measures, whether implemented directly by the BDCP Implementation Office or by
8 other supporting entities through contracts, memoranda of agreement, or other agreements with
9 the BDCP Implementation Office. Compliance monitoring will be conducted to ensure that
10 conservation measures are meeting specified permit terms.

11 **3.6.4.4 Baseline Surveys**

12 Surveys to establish existing baseline conditions are critical to conducting a “before” and “after”
13 comparison of biological and physical conditions related to the implementation of conservation
14 actions and to the evaluation of the effectiveness of those conservation actions (refer to Section
15 3.6.4.5, *Effectiveness Monitoring*, below). Appropriate statistical designs for baseline surveys
16 and effectiveness monitoring will be established as part of development of action-specific
17 monitoring plans (Section 3.6.6, *Development of Specific Monitoring Plans*). Baseline surveys
18 will be performed prior to implementation of conservation actions with sufficient lead time to
19 allow future detection of changes in trajectories for the expected outcomes after implementation.
20 For example, zooplankton sampling would be conducted in channels adjacent to tidal restoration
21 sites in all seasons for multiple years prior to levee breaching to set the baseline condition.
22 Monitoring sampling of zooplankton would be conducted at the same channel locations
23 immediately following the levee breaching and throughout the natural development period of the
24 restored tidal habitat, to quantify changes in the zooplankton community related to increased
25 food availability.

26 Baseline and monitoring survey results will be used as the basis for BACI designs intended to
27 evaluate program effectiveness. In some cases baseline monitoring may involve monitoring at
28 reference (control) sites inside or outside the BDCP area (e.g., habitat use in unaffected habitat
29 areas). BACI design approaches may be used where reference sites are limited.

30 **3.6.4.5 Effectiveness Monitoring**

31 Effectiveness monitoring assesses ecosystem, natural community, and covered species responses
32 to the implementation of conservation measures and monitors progress made toward achieving
33 biological goals and objectives. Effectiveness monitoring will occur at two scales: (1) a local
34 scale focused on evaluating the effectiveness of specific individual conservation measures; and
35 (2) a system-wide scale focused on the status and trends in species populations, natural
36 communities, and ecosystem processes within the Plan Area. Each of these effectiveness
37 monitoring scales are described in more detail below.

1 Effectiveness monitoring will be closely coordinated with baseline monitoring and the BDCP
2 research program to support adaptive management. It is anticipated that the extent of
3 effectiveness monitoring will be reduced over time as causal relationships between the
4 implementation of conservation measures and the responses of covered species and ecosystems
5 to those measures are better understood (as a result of knowledge gained under the BDCP
6 monitoring and research program and other research programs). For example, if relationships
7 between restoration of tidal marsh and zooplankton production are established through
8 monitoring and research on initially restored tidal marshes, then effectiveness monitoring for
9 assessing the production of zooplankton associated with subsequent restoration of tidal marsh
10 may be reduced or no longer required. Effectiveness monitoring will also be spatially stratified to
11 establish the effectiveness of the conservation measures in each Conservation Zone or
12 ecologically relevant portions of the Plan Area.

13 **Conservation Measure Monitoring.** Monitoring focused on specific conservation measures
14 will be undertaken for water operations, physical habitat restoration and enhancement, and other
15 stressors conservation measures implemented by the BDCP Implementation Office and
16 Supporting Entities. BDCP covered species will be monitored to assess individual, population,
17 and community responses directly associated with specific conservation measures. Specific
18 attributes of the aquatic ecosystem that are necessary for the survival and recovery of covered
19 fish species will also be monitored as they relate to specific conservation measures. Monitoring
20 at the local scale will also be used to determine whether any desirable or undesirable
21 consequences are occurring in association with the implementation of specific conservation
22 measures.

23 **System-Wide Monitoring.** Together with the BDCP research program, system-wide monitoring
24 is intended to complement conservation measure monitoring by evaluating the status of
25 ecological processes, natural communities, and covered species across the Plan Area, and in
26 some cases outside of the Plan Area. Information within the scope of system-wide monitoring
27 includes overall status, distribution of organisms, and trends related to covered species
28 populations. Together with the conservation measure monitoring, system-wide monitoring is
29 intended to help determine causality when examining a potential biological response, or lack
30 thereof, to BDCP actions. System-wide monitoring allows for the evaluation of the collective
31 effects of multiple conservation measures through time and provides information specific to the
32 measuring metrics and the achievement of biological goals.

33 Consistent with the BDCP goals and objectives, system-wide monitoring will focus on three
34 levels of ecological scale: (1) ecosystem processes (ecological processes, physical and chemical
35 conditions, and food webs), (2) natural communities (including the ecological functions they
36 provide for covered species), and (3) covered species. Each of these is described below.

37 **Ecosystem Processes.** Within the BDCP conservation lands and the Plan Area, the
38 Implementation Office will monitor the structure and function of the aquatic ecosystems and the
39 processes that influence these attributes at appropriate time intervals and at appropriate locations,

1 over the term of the BDCP. Monitoring of aquatic ecosystem processes and conditions will
2 provide the BDCP Implementation Office with information necessary to track long-term changes
3 affecting the aquatic ecosystem (e.g., covered activities, climate viability and change, activities
4 of others) and to document the contribution of the BDCP toward maintaining and improving
5 aquatic ecosystem attributes in support of the covered fish species.

6 The BDCP Implementation Office will use the best available scientific understanding and
7 datasets associated with the Delta aquatic ecosystem to establish markers from which to assess
8 future changes in ecosystem processes, structure and function. Depending on the type and extent
9 of data gaps, the BDCP Implementation Office will at the outset of Plan implementation collect
10 necessary additional information to better understand existing conditions. If strong relationships
11 between the response of specific ecosystem functions and conservation measures are established,
12 the frequency of system monitoring for those monitoring elements of the Plan may be modified
13 by the BDCP Implementation Office.

14 **Natural Communities.** The BDCP Implementation Office will monitor the extent and
15 distribution of natural communities within the BDCP conservation lands and within the Plan
16 Area at appropriate intervals over the term of the BDCP, depending on the type of community.
17 Monitoring of covered natural communities will provide the BDCP Implementation Office with
18 information sufficient to track long-term changes in the distribution and extent of covered natural
19 communities attributable to any of a number of factors that may affect the communities (e.g.,
20 covered activities, climate variability and change, and activities of others). The results of these
21 monitoring efforts will also provide documentation of the contribution of the BDCP towards
22 maintaining and improving the extent, distribution, and continuity of natural communities. The
23 baseline conditions from which changes in the range and distribution of natural communities will
24 be assessed are the conditions described in Chapter 2, *Existing Ecological Conditions* and
25 Appendix A, *Covered Species Accounts* and in baseline data collected by the Implementation
26 Office early in the implementation period.

27 **Covered Species.** The status, distribution, and trends in populations of covered fish, wildlife, and
28 plant species will be monitored within the BDCP Plan Area over the term of the BDCP. This
29 level of monitoring will provide the BDCP Implementation Office with information sufficient to
30 track long-term changes attributable to factors such as covered activities, physical and chemical
31 changes, and climate variability and change that may affect covered species. The results of these
32 monitoring efforts will document the contribution of the BDCP toward the conservation of
33 covered species and inform system-level assessments of status, trends, and distribution. The
34 baseline conditions from which changes in the range and distribution of covered species will be
35 assessed are the conditions described in Chapter 2, *Existing Ecological Conditions* and Appendix
36 A, *Covered Species Accounts* and in baseline data collected by the Implementation Office early
37 in the implementation period.

38 As part of the covered species monitoring, the BDCP Implementation Office will also review
39 relevant scientific data collected for covered species whose range and life stage distribution

1 extends beyond the BDCP Plan Area as this information becomes available. Review of
2 information gathered outside of the BDCP Plan Area will be sought to further inform
3 assessments of the status and trends relating to covered species within the BDCP Plan Area and
4 for making adjustments to BDCP implementation through the adaptive management process.

5 Species monitoring will be particularly important for covered fish and wildlife species that are
6 migratory, nomadic, or otherwise highly mobile (i.e., dispersing readily in and out of the Plan
7 Area). For these species, factors external to the Plan Area can readily obscure the type and extent
8 of response to the implementation of the BDCP. For example, it may be that a conservation
9 measure intended to restore habitat for a covered species is not followed by use of that habitat.
10 The apparent lack of response, however, may be due to a population decline of the covered
11 species caused by increased mortality outside the Plan Area. To establish causality, a number of
12 monitoring metrics are needed, making use of cross-system comparisons.

13 **3.6.5 Potential BDCP Monitoring Actions and Metrics**

14 Potential monitoring actions and metrics to be implemented by the BDCP Implementation Office
15 are divided into the same ecological hierarchy as the biological goals and objectives and
16 conservation measures. Potential effectiveness monitoring actions and metrics for conservation
17 measures are presented in Table 3-13 and potential monitoring actions and metrics for system-
18 wide monitoring are presented in Table 3-14. Each potential monitoring action includes a
19 description of existing programs that are currently implementing a portion or all of the
20 monitoring action and how the monitoring information is expected to inform adaptive
21 management decision making. All types of monitoring identified in Section 3.6.4, *Types of*
22 *Monitoring*, are addressed in these tables. Tables 3-13 and 3-14 illustrate the types of monitoring
23 actions and metrics that could be implemented, however, the Implementation Office will have
24 the flexibility to determine the specific methods for gathering monitoring information and to
25 change monitoring actions and metrics through the adaptive management process (see Section
26 3.6.6, *Development of Specific Monitoring Plans*, and Section 3.7, *Adaptive Management*
27 *Program*).

28 **3.6.6 Development of Specific Monitoring Plans**

29 The BDCP Implementation Office will prepare detailed monitoring plans tailored to specific
30 conservation measures and to system-wide monitoring needs based on the monitoring actions
31 and metrics in Tables 3-13 and 3-14. These monitoring plans will be developed prior to
32 implementation of the applicable conservation measures and the plans will include specific
33 experimental and statistical designs to allow analysis of the status and trends of the selected
34 metrics using approaches such as BACI analyses (see the discussion of target research in Section
35 3.7.5, *Adaptive Management Experiments*). The monitoring plans will include survey protocols
36 for efforts related to preconstruction, construction, compliance, effectiveness, and system-wide
37 monitoring. In most instances, existing and generally accepted monitoring protocols (e.g.,
38 USFWS survey protocols for listed species, and protocols for monitoring status and trends in

1 abundance and distribution of covered fish species) will be adopted by the BDCP
2 Implementation Office, as appropriate. In some cases, however, the Implementation Office will
3 need to develop specific monitoring protocols to assess a conservation measure.

4 The specific contents of each specific monitoring plan may vary depending on its purpose. The
5 monitoring plans, however, will generally include the following types of information:

- 6 • Description of the purpose and objectives of the monitoring (e.g., assessing progress
7 towards achieving a biological objective);
- 8 • Description of monitoring protocols, including sampling design and justification
9 supporting the validity of monitoring methods and sampling design;
- 10 • Analytical methods for assessing monitoring results;
- 11 • Procedures for validating monitoring data and methods;
- 12 • Monitoring schedule, duration, and rationale;
- 13 • Spatial sampling scheme;
- 14 • Content requirements and submission schedule for monitoring reports;
- 15 • Monitoring data storage and management procedures;
- 16 • Analytical methods for the assessment of data and presentation of results;
- 17 • References, including printed references and personal communications;
- 18 • Provisions for documenting subsequent revisions to the monitoring plan; and
- 19 • Other information pertinent to specific monitoring plans.

20 Because monitoring provides the necessary information to make adjustments in the
21 implementation of the Plan and to measure progress toward achieving the BDCP biological goals
22 and objectives, monitoring plans must be based on the best available information and subject to
23 rigorous standards, including statistically sound sampling designs. To ensure defensibility of the
24 BDCP monitoring plans, protocols, and sampling designs, the Implementation Office will
25 provide for internal science-based review of these monitoring elements as a routine matter and
26 the overall plans will be examined by external science review as necessary and appropriate.

27 **3.6.7 Research Program**

28 While habitat conservation plans and natural community conservation plans are not specifically
29 required to include research programs, the ecological complexity of the Delta and the level of
30 uncertainty regarding the level of anticipated beneficial outcomes for covered species resulting
31 from some of the conservation measures highlight the need for targeted research to better inform
32 BDCP implementation and monitoring and adaptive management decision making. Existing
33 research programs (particularly those funded under the IEP and Delta Science Program) have
34 produced a broad range of valuable information. The BDCP Science Manager will identify

1 research priorities to address specific uncertainties and provide funding for research to support
2 more effective implementation of the Conservation Strategy. The Science Manager will
3 coordinate with other entities, including IEP and the Delta Science Program to identify research
4 needs and priorities. Many of the uncertainties and research needs are stated within the BDCP
5 conservation measures in Section 3.4 *Conservation Measures*.

6 The following provides a preliminary description of how the BDCP will approach its research
7 program. Additional details regarding the research program will be developed as proposed
8 conservation measures are further refined and site-specific designs are developed, including the
9 development of experimental designs to be incorporated with program implementation to support
10 the adaptive management process.

11 BDCP Implementation Office may undertake or contract focused research to develop
12 information necessary to better inform BDCP implementation. The types of research that may
13 be conducted include those related to resolving BDCP-specific questions and needs related to:

- 14 • Key ecological processes and controls on these processes;
- 15 • Technologies and methods for effectively implementing and measuring the outcome of
16 conservation measures;
- 17 • Development of new and more sensitive indicators and metrics;
- 18 • Improving understanding of the ecological requirements of covered species as they relate
19 to effective implementation of conservation measures;
- 20 • Modeling and assessing responses of covered species to conservation measures;
- 21 • Determining causal relationships between ecological stressors and drivers and changes in
22 natural communities and covered species; and
- 23 • Identify and evaluate tradeoffs among conservation measures.

24 Each conservation measure in Section 3.4, *Conservation Measures*, include discussions of
25 hypothesized benefits of the measures that are testable under the either the monitoring program
26 or the research program. Results of research would also be used to help direct and prioritize
27 subsequent implementation of conservation measures through the adaptive management process.

28 The BDCP Implementation Office will use and maintain existing analytical tools (e.g., the
29 DRERIP conceptual models and hydrologic models such as CALSIM, DSM2, and RMA), as
30 appropriate, may also develop or participate in the development of models and other analytical
31 tools to help inform BDCP implementation and support the adaptive management process.
32 These analytical tools include current models and development or improvement of relevant
33 deterministic, statistical, and conceptual models and exploring correlations and the cause and
34 effect relationships between various components of the Delta ecosystem. To develop these
35 modeling and analytical tools, the BDCP Implementation Office may conduct studies to collect
36 information necessary for development of the tools. Additionally, it is anticipated that the BDCP

1 Implementation Office will also participate in revising and improving existing tools (e.g.,
2 hydrologic and hydrodynamic models, DRERIP conceptual models) as new capabilities become
3 available over the term of the BDCP.

4 **3.6.8 Database Development and Maintenance**

5 The BDCP Implementation Office will develop and maintain a comprehensive spatially-linked
6 database to track implementation of all aspects of the BDCP. The database would be structured
7 to be “user friendly” and to allow for future expansion and integration with external databases
8 (e.g., linkage to databases of the Delta Science Program, and California Water Quality
9 Monitoring Council). The database would look to other well recognized database management
10 examples such as the Consortium of Universities for the Advancement of Hydrologic Science
11 and the U.S. Long Term Ecological Research Network, which are leaders in multiple facets of
12 data management in the environmental sciences. Functions that the BDCP database would be
13 expected to support include:

- 14 • Data documentation such that future users can determine why, how, and where data were
15 collected (i.e., metadata);
- 16 • Quality assurance and control of the data and data entry;
- 17 • Access to and use of the most current information for analysis and decision making; and
- 18 • Evaluation of data by all users, as appropriate, and incorporation of corrections and
19 improvements in the data.

20 Major types of information expected to be maintained within the database include:

- 21 • Monitoring, research, and adaptive management experiment data and results;
- 22 • Modeling inputs, outputs, and results;
- 23 • Status of covered activities, including implementation and impacts;
- 24 • Implementation status of conservation measures;
- 25 • Implementation status of research and adaptive management experiments;
- 26 • Adopted changes to BDCP implementation through the adaptive management process; and
- 27 • All reports and documents generated by the Implementation Office and relevant data and
28 reports generated by other entities.

29 The BDCP Implementation Office may choose to develop a web-linked database to facilitate
30 controlled transference of information into and out of the database by other entities. If the BDCP
31 Implementation Office chooses to allow access to the database by others, the database will
32 incorporate strict controls and monitoring to ensure the integrity of the database is maintained.

1 The BDCP Implementation Office will ensure quality control of all monitoring data and will
2 adopt procedures to maintain high standards of quality. Steps will be instituted to maintain the
3 accuracy and functionality of gages, meters, and other devices, and protocols will be established
4 to govern the collection, transcription, and storage of data. All monitoring data will be entered
5 into database software and will be made readily available online once quality control analyses
6 have been conducted.

7 The BDCP Implementation Office will use standard analytical procedures where such
8 procedures exist. Particular analyses would be specific to individual monitoring parameters and
9 would consist of classical parametric or non-parametric hypothesis testing and statistical models
10 (e.g., t-tests, ANOVAs, correlations, regressions, etc.) to the extent practicable. If advanced
11 statistical methods are necessary (e.g., multivariate ANOVAs, principal components analysis,
12 Bayesian statistics, etc.), the BDCP Implementation Office would consult with experts to ensure
13 proper analyses are being conducted. For many parameters, due to high environmental
14 variability, time series analyses will be necessary to assess with confidence whether a trend in a
15 parameter depicts a change that has occurred as a result of a BDCP action. Results of the
16 analysis of monitoring data will feed back into the BDCP adaptive management process to
17 modify and refine conservation measures to maximize benefits to and minimize unanticipated
18 adverse effects on covered species and other components of the aquatic community.

19 **3.6.9 Monitoring and Research Schedule**

20 Following the signing of the Implementing Agreement and authorization of the BDCP, the
21 Implementation Office will develop detailed monitoring plans and schedules for compliance and
22 effectiveness monitoring. In addition, site-specific monitoring schedules will be developed for
23 each BDCP conservation area as they are protected, enhanced, and restored.

24 **3.6.10 Reporting and Science Communication**

25 Requirements for the Reporting of monitoring results are provided in Chapter 6, *Plan*
26 *Implementation*. The BDCP Implementation Office will regularly prepare implementation
27 reports that describe survey, monitoring, research, and experimental activities and results over
28 the term of the BDCP. Regular reporting requirements are described in Section 6.2, *Compliance*
29 *and Progress Reporting*. The Implementation Office will also support peer-reviewed
30 publications, seminars, and conferences like the Delta Science Conference and State of the
31 Estuary Conference as additional mechanisms for communicating information and results. These
32 approaches tend to foster the level of synthesis and integration needed to support an adaptive
33 management approach.

[*Note to Reviewers: This table presents in-progress draft potential effectiveness monitoring actions for each BDCP conservation measure. This table will continue to be refined and populated to ensure that all of the effectiveness monitoring, including incorporation of metrics from the Logic Chain, are addressed.*]

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures

Base Conditions, Approach, and Schedule	Applicable IEP and other Programs and Potential Additions to those Programs	Metrics	Adaptive Management Considerations	Objectives addressed
Ecosystem-Level Conservation Measures				
CM1: Water Facilities and Operation				
<i>Monitoring Action CM1-1. Document the operation of the new water diversion facility in the north Delta with multiple intakes and fish screens and an isolated conveyance facility while maintaining sufficient bypass flows for covered fish species.</i>				
<p>Base condition: As-built construction drawings.</p> <p>Approach: Record amounts and timing of water diversion and conveyance, record bypass flows at automated monitoring stations downstream of the last intake.</p> <p>Schedule: real-time data compiled for daily summaries.</p>	<p>Existing Programs:</p> <ol style="list-style-type: none"> 1. Continuous Multi-parameter Monitoring, Discrete Physical /Chemical Water Quality Sampling (Environmental Monitoring program; IEP) 2. Continuous Recorder Sites (DWR, USBR) 3. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program (Central Valley Water Board) 4. Delta Flows Network and National Water Quality Assessment Program (USGS) 5. other (DWR, SRCSD, SWAMP, Central Valley Water Board, State Water Board, SFEI, etc) <p>Potential Program Additions: add automatic water monitoring stations at each intake as needed.</p>	<ol style="list-style-type: none"> 1. Hourly Intake (cfs) 2. Bypass flow (cfs) downstream of last intake 	<p>This monitoring action will provide real-time data on the amount of water diverted by the north Delta diversion facility, and the amount of water that bypasses the facility.</p> <p>This information will be used by the Implementing Office to determine if water operations adhere to existing target levels.</p> <p>The monitoring schedule may be adjusted to better estimate diversion and bypass flows.</p>	<p>ECSY1.1 ECSY1.2 ECSY1.3 ECSY1.4 ECSY1.5 ECSY4.1 DESM1.3 DESM1.4 LOSM1.1 LOSM1.2 LOSM1.4 CHSA1.5 STEE1.4 GRST1.1 WHST1.1 RILA1.4 PALA1.4</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<i>Monitoring Action CM 1-2: Record and quantify the number of fish impinged at intakes of the new water diversion facility in the north Delta.</i>				
<p>Base condition: As-built construction drawings.</p> <p>Approach: Time stratified sampling; record number, size, species and life stage, reproductive status of impinged fish at intake screens; Install underwater monitoring cameras at fish screens to examine fish behavior at intake screens</p> <p>Schedule: Daily</p>	<p>Existing Programs: Protocols, equipment and skilled personnel working at CVP and SWP facilities (south Delta)</p> <p>Potential Program Additions: Equipment and staff to monitor north Delta diversion facility using identical protocols; protocols for analyzing video sequences of underwater cameras</p>	<ol style="list-style-type: none"> 1. Number of fish 2. Species 3. Life stage 4. Reproductive status 	<p>This monitoring action will provide data on impingement of covered fish species at the North Delta facilities. This information will be used by the Implementing Office to determine if the existing fish screens perform to meet target thresholds. It will also provide insights in fish behavior at intakes and will be used to evaluate and redesign fish screens if necessary. The monitoring schedule may be intensified if large numbers of fish are impinged at any given time/season.</p>	<p>DESM1.5 LOSM1.4 CHSA1.7 STEE1.6 SASP1.4 GRST1.6 WHST1.6</p>
<i>Monitoring Action CM 1-3: Record and quantify the number of fish entrained at the south Delta SWP and CVP pumping facilities.</i>				
<p>Base Condition: Current levels of entrainment</p> <p>Approach: Use existing protocols and sampling procedures, continue to collect entrainment and salvage data at CVP and SWM pumping stations.</p> <p>Schedule: ongoing, daily</p>	<p>Existing Programs: Ongoing fish sampling at pumping facilities, IEP Monitoring (Fishery Improvements) coordinated with DWR, DFG, USBR, UCD, and other federal, state, and local agencies.</p> <p>Potential Program Additions: None</p>	<ol style="list-style-type: none"> 1. Monthly salvage density (fish/cubic foot per second [cfs]) 2. Estimated entrainment (numbers) 3. Estimated impingement (numbers) 4. Species composition 5. Size distribution of individual species 	<p>This monitoring provides information about the seasonal distribution and amount of fish losses due to entrainment at pumping facilities</p> <p>The Implementation Office will use this information as input in population and life-cycle models of covered fish, and to determine if fish salvage and screening perform at expected target levels. This monitoring activity is already adaptively scheduled by adjusting sampling according to the number of fish</p>	<p>CHSA1.7 DESM1.5 GRST1.6 LOSM1.4 SASP1.4 STEE1.6 WHST1.6</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			entrained and by flow. Modification of this sampling is not expected.	
<i>Monitoring Action CM1-4: Document diversion operations to ensure target flows in Old and Middle Rivers.</i>				
<p>Base Condition: Pre-implementation flows of Old and Middle Rivers.</p> <p>Approach: Use existing network of fixed-site sampling stations to collect time-histories of water quality variables. Derive flux between regions in the Delta through these key channels.</p> <p>Schedule: Within 1 year of initiation of the South Delta Diversion Operational Limits, operate monitoring sites and track flow on a daily basis.</p>	<p>Existing Programs:</p> <ol style="list-style-type: none"> 1. Continuous Multi-parameter Monitoring, Discrete Physical /Chemical Water Quality Sampling (Environmental Monitoring program; IEP) 2. Continuous Recorder Sites (DWR, USBR) 3. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program (Central Valley Water Board) 4. Delta Flows Network and National Water Quality Assessment Program (USGS) 5. other (DWR, SRCSD, SWAMP, Central Valley Water Board, State Water Board, SFEI, etc) <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. If needed, add complementary stations to track water flows within Old and Middle River. <p>see also Monitoring Action CM4-4 and Monitoring Action CM4-6.</p>	<ol style="list-style-type: none"> 1. Flow dynamics (velocity and volume of flows, direction) in Old and Middle River 	<p>This monitoring action will provide information regarding the effectiveness of adaptive operational changes of Old and Middle River flows (by modifications in export rates and reverse flows).</p> <p>The Implementing Office will use this information to determine if flow rates are within adaptive range limits.</p> <p>The schedule for monitoring may be changed if flow dynamics are found not to be within not adaptive range limits.</p>	<p>ECSY1.1 ECSY1.2 ECSY1.3 ECSY1.4 ECSY1.5 DESM1.3 DESM1.4 LOSM1.2 CHSA1.5 STEE1.4 PALA1.4 RILA1.4</p>
<i>Monitoring Action CM1-5: Document fish migration and hydrodynamics (including hydraulic residence time) resulting from Delta Cross Channel operations (increasing the duration of Delta Cross Channel closure).</i>				
<p>Baseline Condition: Current knowledge of migration routes of covered fish species; if necessary determine proportion of covered juvenile fish (salmonids and sturgeon) migrating through the interior Delta and the mainstem of the Sacramento River.</p> <p>Approach: Conduct tracking</p>	<p>Existing Programs:</p> <ol style="list-style-type: none"> 1. Previous salmon survival and migration studies (e.g., USFWS, Perry et al. 2010), ultrasonic recorder stations (USGS & California Bay-Delta Authority). 2. Water quality monitoring sites within the Delta (see CM1-1). <p>Potential Program Additions: Implement a routine juvenile fish migration and survival</p>	<ol style="list-style-type: none"> 1. Migration routes (% individuals moving through the mainstem) by juvenile salmon and sturgeon 2. route- and species-specific survival estimates 3. Hydraulic residence time 	<p>This monitoring will provide information on the effectiveness of Delta Cross Channel closure to increase covered fish survival and by improving downstream transport of fish eggs, larvae, juveniles and organic food resources.</p>	<p>CHSA1.5 STEE1.4 RILA1.4 PALA1.4</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>(e.g., radio-telemetry, acoustic tracking, or other appropriate methods) of juvenile winter-run Chinook salmon, green and white sturgeon, and other species as appropriate to determine the proportion of fish migrating through the mainstem Sacramento River and tributaries and the interior of the delta and their survival. Compare water quality and organic food indices among migration routes and under different flow regimes and Cross Channel gate operation.</p> <p>Schedule: During migration track marked fish daily. Aggregate data by month and derive mortality estimates for fish in each migration route (mainstem vs interior).</p>	<p>tracking program by experimentally releasing tagged fish to determine the effects of Cross Channel Closure on survival.</p>	<p>4. Flows and downstream transport of fish eggs, larvae, juveniles, organic material, phytoplankton, and zooplankton, within the Sacramento River into the Delta.</p>	<p>Results of this monitoring will be used within the BDCP adaptive management framework to refine and modify seasonal operations of Delta Cross Channel gates.</p> <p>The schedule of monitoring may be adaptively altered if data resolution requirements are not met or when a clear relationship between Delta Cross channel operation, covered species survival and transport, and tidal flows is established and can be predicted robustly and with low uncertainty.</p>	
<p><i>Monitoring Action CMI-6: Document achievement of minimum flow requirements at Rio Vista to support fishery and aquatic habitat in the reach of the Sacramento River between Sacramento and Rio Vista.</i></p>				
<p>Base Condition: Existing data and modeling results for flow statistics of the Sacramento river between Sacramento and Rio Vista</p> <p>Approach: Using the existing network of fixed-site sampling stations, collect time-histories of water quality variables. Derive flow rates.</p>	<p>Existing Programs:</p> <ol style="list-style-type: none"> 1. Continuous Multi-parameter Monitoring, Discrete Physical /Chemical Water Quality Sampling (Environmental Monitoring program; IEP) 2. Continuous Recorder Sites (DWR, USBR) 3. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program (Central Valley Water Board) 4. Delta Flows Network and National Water Quality Assessment Program (USGS) 	<ol style="list-style-type: none"> 1. Flow dynamics (cfs) of the Sacramento River reach between Sacramento and Rio Vista. 	<p>This monitoring action will provide information regarding the effectiveness of adaptive operational changes to ensure minimum flows at Rio Vista to support fishery and aquatic habitat in the reach of the Sacramento River between Sacramento and Rio Vista.</p> <p>The Implementing Office will</p>	<p>ECSY1.1 ECSY1.2 ECSY1.3 ECSY1.4 ECSY1.5 DESM1.4 LOSM1.2 CHSA1.5 STEE1.4 GRST1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Schedule: Operate monitoring sites and track flow on a continuous basis for at least 5 years or until a robust predictive model can be derived from the monitoring data that allows forecasting of flow rates as a product of operational and other variables.</p>	<p>5. other (DWR, SRCSD, SWAMP, Central Valley Water Board, State Water Board, SFEI, etc)</p> <p>Potential Program Additions: 1. If needed, add complementary stations to track water flows within The Sacramento River between Sacramento and Rio Vista. see also Monitoring Action CM4-4 and Monitoring Action CM4-6.</p>		<p>use this information to determine if flow rates are within adaptive range limits.</p> <p>The schedule for monitoring may be changed if flow dynamics are found not to be within not adaptive range limits.</p>	<p>WHST1.1 RILA1.4 PALA1.4</p>
<p><i>Monitoring Action CMI-7: Monitor Delta outflows during the near-term implementation period for environmental benefits.</i></p>				
<p>Base Condition: Current Delta Outflows; seasonal position of 350 µS/cm EC isohaline (X2).</p> <p>Approach: Continue monitoring salinity via the fixed water quality stations throughout the Delta. Obtain Daily and seasonal dynamics to determine if and when Delta outflows are below target levels.</p> <p>Schedule: Daily monitoring via fixed station network.</p>	<p>Existing Programs: 1. IEP Monitoring Data– daily average surface salinity at fixed stations along the Sacramento River interpolated to determine the location of 350 µS/cm EC isohaline. 2. DSM2 Simulations – daily average, depth-averaged salinity at fixed locations (every DSM2 node) along the Sacramento River is interpolated to determine the location of 350 µS/cm EC isohaline.</p> <p>Potential Program Additions: none</p>	<ol style="list-style-type: none"> 1. Daily average surface salinity at fixed stations. 2. Interpolated position of the isohaline (X2), expressed in miles from the Golden Gate Bridge. 3. Net Delta Outflow Index 	<p>This monitoring action will provide information on the magnitude of Delta outflow and related parameters (salinity intrusion). It will track the position of the isohaline</p> <p>Based on results and analysis of monitoring data, adaptive modifications to management of Delta outflow under the BDCP adaptive management framework could occur by modifying operational criteria by season or water-year type (hydrology).</p> <p>The schedule of monitoring actions may be altered to improve precision and accuracy of estimating the position of the isohyaline.</p>	<p>ECSY1.1 ECSY1.2 ECSY1.3 ECSY1.4 ECSY1.5 DESM1.4 LOSM1.2 CHSA1.5 STEE1.4 GRST1.1 WHST1.1 RILA1.4 PALA1.4</p>
<p><i>Monitoring Action CMI-8: Record in-Delta agricultural, municipal, and industrial water quality.</i></p>				
<p>Base condition: Current water quality monitoring</p>	<p>Existing Programs: 1. Continuous Multi-parameter Monitoring,</p>	<p>1. EC (salinity)</p>	<p>This monitoring action is intended to collect data</p>	<p>DESM1.3 DESM1.4</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Approach: Continue current water quality monitoring as mandated by existing D-1641 North and Western Delta agricultural and municipal and industrial (M&I) standards and all water quality requirements contained in the North Delta Water Agency/DWR Contract and other DWR contractual obligations.</p> <p>Schedule: as currently implemented.</p>	<p>Discrete Physical /Chemical Water Quality Sampling (Environmental Monitoring program; IEP)</p> <p>2. Continuous Recorder Sites (DWR, USBR)</p> <p>3. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program (Central Valley Water Board)</p> <p>4. Delta Flows Network and National Water Quality Assessment Program (USGS)</p> <p>5. other (DWR, SRCSD, SWAMP, Central Valley Water Board, State Water Board, SFEI, etc)</p>	<p>2. Water temperature (°C)</p> <p>3. mg/L dissolved oxygen</p> <p>4. Turbidity (NTUs)</p> <p>5. Concentration (µg/L) of ammonia, pyrethroids, copper, organophosphates</p> <p>6. pH</p> <p>7. mg methylmercury/L</p>	<p>necessary to determine if salinity conditions are meeting contractual and legal requirements.</p> <p>This information will be used to address deviations from salinity target conditions, and design modifications and/ research studies to address uncertainty in salinity control.</p> <p>The monitoring schedule may be adjusted in response to monitoring results to better understand causal relationships between water management and salinity.</p>	<p>LOSM1.2</p> <p>CHSA1.3</p> <p>GRST1.3</p> <p>GRST1.4</p> <p>WHST1.3</p> <p>WHST1.4</p> <p>RILA1.5</p> <p>PALA1.5</p>
<p><i>Monitoring Action CM 1-9: Document and quantify effects of modified/reduced operations the Montezuma Slough Salinity Control Gate for covered fish species passage and salinity</i></p>				
<p>Base Condition: current operation and flows (local current patterns and tidal hydrodynamics).</p> <p>Approach: continue to monitor and calculate water quality and flow parameters through Suisun Marsh and at Chipps Island (Delta Net outflow index), continue IEP Suisun Marsh fish monitoring (otter trawls and beach seines)</p> <p>Schedule: instantaneous automatic 15 min interval recording of salinity data, Seasonal fish abundance as</p>	<p>Existing Programs: IEP coordinated programs:</p> <p>1. Suisun Marsh Water Quality Monitoring and Compliance (five compliance stations);</p> <p>2. Aquatic Monitoring by University of California Davis (UCD) and DFG in Suisun Marsh (otter trawls and beach seine)</p> <p>Potential Program Additions: none</p>	<p>1. Catch per unit effort (CPUE) and % change (over baseline conditions) of outmigrating juvenile salmonids and sturgeon in Suisun Marsh;</p> <p>2. Catch per unit effort (CPUE) and % change (over baseline conditions) of splittail, salmonids, and sturgeon in existing and future restored intertidal marsh habitats in Suisun Marsh (see also CM 4-5).</p>	<p>This monitoring action provides information on the effects of changing or eliminating salinity control gate operations in Montezuma Slough on covered fish species and salinity levels within the Delta.</p> <p>In the event that the control structure remains in place and the gates are opened, results of monitoring could be used in the future to adaptively manage the control gates (resume gate operations) if unexpected</p>	<p>LOSM1.2</p> <p>CHSA1.1</p> <p>CHSA1.4</p> <p>STEE1.1</p> <p>STEE1.3</p> <p>RILA1.4</p> <p>PALA1.4</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
currently conducted by IEP.		3. Salinity levels within Suisun marsh and in adjacent Delta channels 4. Flow (cfs) in Montezuma Slough	undesirable consequences are detected. If the control structure is removed, adaptive management of salinity regimes will require modifications of Delta outflow to manage salinity within the marsh. The monitoring schedule may be adjusted to better inform management decisions if deemed necessary.	
CM2: Yolo Bypass Fisheries Enhancements				
<i>Monitoring Action CM2-1: Document the operation of the modified Fremont Weir (i.e., elevation reduction)</i>				
<p>Base Condition: As-built construction drawings.</p> <p>Approach: Document flow over the weir. Document the operation of inundation gates and deep channel fish passage gates.</p> <p>Schedule: real-time recording, during flooding of the weir.</p>	<p>Existing Programs: CA Dept of Water Resources/NCRO river stage monitoring gages</p> <p>Potential Program Additions: real-time recording of gate operations (open/closed)</p>	1. River stage at Fremont weir 2. Flow (cfs) 3. Gate status (open/closed)	<p>This monitoring action will provide information on the operation of the modified Fremont weir, particularly on the number of days and the amount of water that flows over the weir into Yolo bypass and the operation of the fish passage gates at below flood stage of the Sacramento River (11.5 – 17.5 ft)</p> <p>This information will be used by the Implementing Office to refine operation of the gates to provide for the inundation of the Yolo bypass according to target levels.</p> <p>The monitoring schedule may be adjusted if deemed</p>	ECSY1.2 ECSY2.1 CHSA1.1 CHSA1.4 CHSA1.5 STEE1.1 STEE1.2 STEE1.3 SASP1.1 SASP1.2 GRST1.5 WHST1.5 RILA1.3 PALA1.3

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			necessary to provide higher resolution information for gate operations.	
<i>Monitoring Action CM2-2: Document the effects of the fish passage gates at Fremont Weir (replacing fish ladder)</i>				
<p>Base conditions: As-built construction drawings.</p> <p>Approach: Install and operate underwater high resolution cameras and or automatic fish counters (using resistivity, infrared scanning technology or other appropriate methods) to characterize and quantify covered fish species passing through fish passage gates within the inundation channel during flooding of the Yolo Bypass. Compile and analyze fish passage data daily during operation of the passage gates.</p> <p>Schedule: real-time instantaneous fish counting when fish passage gates are open.</p>	<p>Existing Programs: none</p> <p>Potential Program Additions: Automated fish counting technology (automatic counter sensors, computer system and software to scan, recognize and measure fish); skilled personnel to manage and analyze fish counter data; See Monitoring Action CM2-7, CM2-10, CM2-11</p>	<ol style="list-style-type: none"> 1. Number of fish passing through the gates 2. Species 3. Size class 4. Origin (wild or hatchery for fin-clipped fish) 	<p>This monitoring action will provide information to quantify adult fish passage from the up- and downstream between the Sacramento River and the Yolo Bypass.</p> <p>This information will be used by the Implementing Office to estimate the population size of adult covered fish species using the Yolo bypass during inundation.</p> <p>The monitoring schedule will be adjusted during inundation events and status of fish passage gates.</p>	<p>CHSA1.1 CHSA1.4 CHSA1.5 STEE1.1 STEE1.2 STEE1.3 SASP1.1 SASP1.2 GRST1.5 WHST1.5 RILA1.3 PALA1.3</p>
<i>Monitoring Action CM2-3: Document the effects of the Yolo Bypass modifications to improve distribution (e.g., wetted area) and hydrodynamic characteristics (e.g., residence times, flow ramping, and recession) of water moving through the Yolo Bypass.</i>				
<p>Base conditions: as-built construction drawings; current extent of Yolo bypass inundation and hydroperiod</p> <p>Approach: Document and quantify grading, removal of existing berms, levees, and water</p>	<p>Existing Programs: Yolo bypass inundation gauging stations at Fremont weir (USGS), Sacramento Weir (USGS) and Lisbon (DWR). Potential GIS capability with DWR IISS section within DWR-DES</p> <p>Potential Program Additions:</p>	<ol style="list-style-type: none"> 1. Yolo bypass wetted area 2. Residence times 3. Flow ramping rate (change of water flow cms/hr hour) 4. Recession timelines 	<p>This monitoring action will provide information on the relationships between the hydrological conditions within the Yolo bypass as they pertain to fish habitat, and flood gage information provided throughout the basin.</p>	<p>ECSY2.1 CHSA1.1 CHSA1.4 CHSA1.5 STEE1.1 STEE1.2 STEE1.3 SASP1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>control structures, construction of berms or levees, re-working of agricultural delivery channels, and earthwork or structures by remote sensing data and field observations entered into GIS. Record and quantify the hydrodynamic characteristics of the Yolo basin by flood and spill gages and satellite imagery (LANDSAT or similar to estimate extent of wetted area). Develop correlation between the extent wetted, hydrodynamic indicators and flood gage measurements. Update GIS database if lands are acquired in fee-title or through conservation or flood easements.</p> <p>Schedule: Daily monitoring of flood gauges, weekly acquisition of remote sensing data, until a correlation can be established between stage at various flood gauges and hydrodynamic measures.</p>	<p>Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab)</p>		<p>This information will be used to determine the operational constraints and effectiveness of gate and spill operations of the Fremont weir and flow obstruction removals within the floodplain. It will also be used to assess if additional floodplain modifications are necessary to reduce flow and inundation impediments, and to address erosion and other issues.</p> <p>The monitoring schedule may be modified once robust, statistically significant and precise correlations have been verified.</p>	<p>SASP1.2 GRST1.5 WHST1.5 RILA1.3 PALA1.3</p>
<p><i>Monitoring Action CM2-4: Document and quantify the effectiveness of Experimental Sturgeon Ramps for the upstream migration of sturgeon from the Yolo bypass to the Sacramento River.</i></p>				
<p>Base condition: as-built construction drawings</p> <p>Approach: Install and operate underwater high resolution cameras and automatic fish counters (using infrared scanning technology, resistivity sensors or</p>	<p>Existing Programs: none</p> <p>Potential Program Additions: Automated fish counting technology (automatic counter sensors, computer system and software to scan, recognize and measure fish); skilled personnel to manage and analyze fish</p>	<ol style="list-style-type: none"> 1. Number of fish passing 2. Species 3. Size class 	<p>This monitoring action will provide information on the effectiveness of experimental Sturgeon Ramps at the Fremont Weir to allow passage of adult sturgeon and lamprey from the Yolo Bypass over the Fremont Weir and into the Sacramento</p>	<p>GRST1.5 WHST1.5</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>other appropriate methods) to characterize and quantify covered fish species passing through sturgeon ramps when weir spills exceed 2 feet.</p> <p>Schedule: instantaneously count and record fish using ramps. Compile counts daily.</p>	<p>counter data; live video feed to web-based application</p> <p>See CM 2-2</p>		<p>River.</p> <p>This information will be used by the Implementing Office within the adaptive management experiment framework to estimate passage rates, refine design features or formulate alternative designs.</p> <p>The monitoring schedule may be adjusted to data needs or may be reduced when effectiveness of the sturgeon ramps has been documented with low uncertainty.</p>	
<i>Monitoring Action CM2-5: Document Stilling Basin Modification and assess risk of covered fish stranding.</i>				
<p>Base conditions: As-built construction drawings</p> <p>Approach: Document the physical changes in stilling basin topography. Estimate the number of fish stranding in the stilling basin as flows are receding by electro-fishing, beach seining or other appropriate method.</p> <p>Schedule: Sample if standing water remains within the basin after weir spills have ceased and floodplain drainage has begun.</p>	<p>Existing Programs: Intermittent and historical IEP and USFWS beach seine and trawling methods within the Yolo and Sutter bypasses</p> <p>Potential Program Additions: Fish sampling of stilling basin to verify stranding.</p> <p>See CM5-2</p>	<p>Number of fish Size species</p>	<p>This monitoring action will provide information to assess if the basin drains sufficiently into the deep fish passage channel and thus will prevent stranding of juvenile and adult fish.</p> <p>Information from this monitoring action will be used by the Implementing Office to assess the risk of stranding at the stilling basin, and to guide the redesign if necessary, if significant numbers of fish are found to be stranded in the basin after re-contouring.</p> <p>The monitoring schedule will</p>	<p>CHSA1.1 CHSA1.4 CHSA1.5 STEE1.1 STEE1.2 STEE1.3 SASP1.1 SASP1.2 GRST1.5 WHST1.5 RILA1.2 RILA1.3 PALA1.2 PALA1.3</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			be reduced to annual visits at the end of the inundation period once fish escape of from the basin has been verified with low uncertainty.	
<i>Monitoring Action CM2-6: Document and evaluate Sacramento Weir improvements for fish passage and minimization of standing risk.</i>				
<p>Base condition: As-built construction drawings.</p> <p>Approach: Document modifications to the weir. Using fish sampling (seining, electro-fishing, traps), determine the number and species of juvenile and adult fish using the stilling basin and (if implemented) fish ladders. Install automatic fish scanners and underwater high-resolution cameras to assess passage of adult fish over the weir into the Sacramento River.</p> <p>Schedule: Weekly sampling of fish until a minimal stranding risk has been estimated and verified precisely. Instantaneous video monitoring of fish passing through fish ladder.</p>	<p>Existing Programs: none</p> <p>Potential Program Additions: Intermittent fish sampling during and after weir spills in Sacramento weir stilling basin; automated fish counting technology (computer system and software to scan, recognize and measure fish); skilled personnel to manage and analyze fish counter data;</p> <p>See Monitoring Action CM2-2</p>	<p>Number, size and species of fish passing over fish ladder</p> <p>Number, species and life stage of juvenile fish sampled in the stilling basin</p>	<p>This monitoring action will provide information on the effectiveness of modifications of the Sacramento weir and its stilling basin to allow passage of adult and juvenile fish from the Yolo Bypass into the Sacramento River or downstream the Tule Canal/Toe Drain to escape stranding.</p> <p>This information will be used by the Implementing Office within the adaptive management experiment framework to estimate passage rates, refine design features or formulate alternative designs.</p> <p>The monitoring schedule may be adjusted to data needs or may be reduced when effectiveness of the implemented modifications has been documented with low uncertainty.</p>	<p>CHSA1.3 CHSA1.1 CHSA1.4 CHSA1.5 STEE1.1 STEE1.2 STEE1.3 SASP1.1 SASP1.2 GRST1.5 WHST1.5 RILA1.2 RILA1.3 PALA1.2 PALA1.3</p>
<i>Monitoring Action CM2-7: Document the Tule Canal/Toe Drain Improvements to increase hydrologic connectivity.</i>				
<p>Base condition: As-built construction drawings.</p>	<p>Existing Programs: none</p>	<p>1. flow (cfs)</p>	<p>This monitoring action will provide information on the</p>	<p>CHSA1.4 CHSA1.5</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Approach: Document modifications to the Tule Canal /Toe drain. Measure flow within the channel with automatic gages.</p> <p>Schedule: Real-time continuous automatic flow measurements.</p>	<p>Potential Program Additions: Install automatic flow gage within the Tule Canal /Toe drain</p>		<p>effectiveness of modifications of the Tule Canal /Toe drain to allow passage of adult and juvenile fish downstream the Tule Canal/Toe Drain to escape stranding.</p> <p>This information will be used by the Implementing Office within the adaptive management experiment framework refine design features or formulate alternative designs.</p> <p>The monitoring schedule may be adjusted to data needs or may be reduced when effectiveness of the implemented modifications has been documented with low uncertainty.</p>	<p>STEE1.3 STEE1.4 GRST1.1 GRST1.5 WHST1.1 WHST1.5 RILA1.3 RILA1.4 PALA1.3 PALA1.4</p>
<p><i>Monitoring Action CM 2-8: Determine the effectiveness of Lower Putah Creek realignments to improve upstream and downstream passage of Chinook salmon and steelhead in Putah Creek and floodplain habitat restoration.</i></p>				
<p>Base condition: As-built construction drawings.</p> <p>Approach: Document modifications to Lower Putah Creek. Using automatic resistivity-based fish counters to detect and enumerate adult fish returning.</p> <p>Schedule: Continuous operation of the fish counter during</p>	<p>Existing Programs: none</p> <p>Potential Program Additions: Install automatic fish counter within Lower Putah Creek.</p> <p>See Monitoring Action CM2-7</p>	<p>1. Number of fish returning 2. Species</p>	<p>This monitoring action will provide information on the effectiveness of modifications of Lower Putah Creek to allow passage of adult and juvenile covered fish along Lower Putah Creek.</p> <p>This information will be used by the Implementing Office within the adaptive management experiment</p>	<p>CHSA1.3 STEE1.3 GRST1.5 WHST1.5 RILA1.3 PALA1.3</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>spawning season.</p>			<p>framework refine design features or formulate alternative designs.</p> <p>The monitoring schedule may be adjusted to data needs or may be reduced when effectiveness of the implemented modifications has been documented with low uncertainty.</p>	
<p><i>Monitoring Action CM 2-9: Determine upstream migration success of salmonids, sturgeon, and lamprey through the Yolo Bypass.</i></p>				
<p>Base condition: existing knowledge of upstream migration and its correlation with flow (DFG data)</p> <p>Approach: Using a combination of mark-recapture and automatic resistivity-based fish counters and high-resolution underwater camera systems at Fremont weir, detect and enumerate adult fish returning (see Monitoring Action CM2-7).</p> <p>Schedule: Continuous operation of the fish monitoring system during migration season</p>	<p>Existing Programs: DFG fish tagging program</p> <p>Potential Program Additions: automated fish counting technology (computer system and software to scan, recognize and measure fish); skilled personnel to manage and analyze fish counter data;</p> <p>See Monitoring Action CM2-2, CM2-6, CM2-10.</p>	<ol style="list-style-type: none"> 1. Number of fish passing 2. Species 3. Size class 	<p>This monitoring action will provide information on the effectiveness of adult covered fish species migrating from the Yolo Bypass over the Fremont Weir and into the Sacramento River.</p> <p>This information will be used by the Implementing Office within the adaptive management experiment framework to estimate passage rates, refine design features or formulate alternative designs.</p> <p>The monitoring schedule may be adjusted to data needs or may be reduced when effectiveness of permeability of the Yolo Bypass for upstream migration of adult fish has been documented with low uncertainty.</p>	<p>CHSA1.3 STEE1.3 GRST1.5 WHST1.5 RILA1.3 PALA1.3</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<i>Monitoring Action CM 2-10: Determine passage rates of covered salmonids, sturgeon, Sacramento splittail, and lamprey from the Sacramento River into the Yolo Bypass during periods of Fremont Weir operation.</i>				
<p>Base condition: As-built construction drawings.</p> <p>Approach: Using a mark-recapture approach, determine the number and species of juvenile and fish out migrating over the Fremont weir. Install automatic fish scanners and underwater high-resolution cameras to assess passage of adult fish over the weir into the Sacramento River.</p> <p>Schedule: Weekly sampling of fish for the period of inundation. Instantaneous video monitoring of fish passing through fish ladder.</p>	<p>Existing Programs: none</p> <p>Potential Program Additions: Intermittent fish sampling during and after weir spills; automated fish counting technology (computer system and software to scan, recognize and measure fish); skilled personnel to manage and analyze fish counter data;</p> <p>See Monitoring Action CM2-2, CM2-7, CM2-10</p>	<p>Number, size and species of fish passing over fish ladder</p> <p>Number, species and life stage of juvenile fish sampled in the stilling basin</p>	<p>This monitoring action will provide information on the effectiveness of modifications of the Sacramento weir and its stilling basin to allow passage of adult and juvenile fish from the Yolo Bypass into the Sacramento River or downstream the Tule Canal/Toe Drain to escape stranding.</p> <p>This information will be used by the Implementing Office within the adaptive management experiment framework to estimate passage rates, refine design features or formulate alternative designs.</p> <p>The monitoring schedule may be adjusted to data needs or may be reduced when effectiveness of the implemented modifications has been documented with low uncertainty.</p>	<p>ECSY2.1 CHSA1.2 STEE1.2 SASP1.2</p>
<i>Monitoring Action CM 2-11: Determine zooplankton and invertebrate production rates during periods the Fremont Weir is operated.</i>				
<p>Base Condition: existing data on Yolo Bypass zooplankton productivity</p> <p>Approach: Establish monitoring stations at inflow and outflow</p>	<p>Existing Programs: Environmental Monitoring Program (EMP, under IEP)</p> <p>Potential Program Additions: 1. Additional sampling stations in the Yolo Bypass floodplains to reflect the before-after-control-impact design. Locations of some</p>	<p>1. Phytoplankton species composition/relative abundance 2. Phytoplankton density (mg/L chlorophyll a)</p>	<p>This monitoring action is intended to collect data necessary to determine and quantify the degree to which the Yolo bypass is producing and exporting phytoplankton</p>	<p>ECSY2.1 CHSA1.2 STEE1.2 SASP1.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>locations and within the inundated floodplain of the Yolo bypass. Take weekly grab samples and measurements of chlorophyll a and zooplankton.</p> <p>Schedule: Conduct sampling for the first 5 years following reestablishment of tidal flow and every 5 years thereafter.</p>	<p>added stations will be fixed during the duration of the plan (systemwide monitoring to detect increase on food availability in delta waterways), others are added to account for different flow rates and inundation depth in dry vs wet years to track how food production develops over time.</p> <p>Sampling stations will also provide water quality data (e.g., temperature, turbidity, pH for ammonia conversion, amount of organic carbon)</p> <p>Invertebrate sampling should be adaptively adjusted to changes in fish diets – see also: Monitoring Action CM4-4, CM4-6, and CM16-5</p>	<p>3. Zooplankton species composition/relative abundance</p> <p>4. Zooplankton density (number/1,000 m³)</p>	<p>and zooplankton into the Delta.</p> <p>This information, in combination with evaluation of other foodweb-related monitoring and research data, will provide the basis for :</p> <ol style="list-style-type: none"> 1. Identifying sources of uncertainty and the design of management experiments and/ research studies, to address uncertainty. 2. evaluating underlying conceptual models and hypotheses (source-sink dynamics, variability and uncertainty in primary production response) 3. evaluating restoration design options to increase the production and export of primary production inundated floodplains 4. Implementing additional management actions to improve production and export of primary production from the floodplain. <p>The monitoring schedule will be modified if uncertainty or variances do not support a clear</p>	

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			causal relationship between floodplain inundation and food production and - exports.	
<i>Monitoring Action CM 2-12: Determine growth rates of juvenile salmonids entering the Yolo Bypass during periods of Fremont Weir operation.</i>				
<p>Base condition: Current studies and knowledge about salmon growth and survival in the Delta and the Yolo bypass.</p> <p>Approach: Conduct routine mark-recapture and radio-telemetry tagging experiments by marking juvenile salmon within the Yolo bypass and measuring survival and growth rates at Chipps Island</p> <p>Schedule: annually mark and radio-tag individual Chinook for at least 5 years. Repeat mark-recapture monitoring every 5th year</p>	<p>Existing Programs: IEP mid-water trawl at Chipps Island, previous salmon survival studies (Perry et al 2009)</p> <p>Potential Program Additions: 1. routine radio-tracking and mark recapture program</p>	<p>1. survival rates 2. growth rates (mm/d)</p>	<p>This monitoring action provides information on the effectiveness of modifying the Fremont weir to benefit survival and growth rates of juvenile outmigrating Chinook salmon.</p> <p>The implementing Office will use this information to determine if operation of the Fremont weir is achieving target levels of survival and growth. The information will also ser as a basis to determine f additional research should be conducted, and if initial models and hypotheses are supported by monitoring data. The monitoring schedule may be extended if survival and growth data are inconclusive to determine that survival and growth has achieved target levels or of substantial environmental variability has increased the level of uncertainty associated with predicted outcomes.</p>	<p>CHIN1.2 STEE1.2</p>
<i>Monitoring Action CM 2-13: Determine escapement success of juvenile covered salmonids, sturgeon, Sacramento splittail, and lamprey from the Yolo Bypass during periods of Fremont Weir operation.</i>				
Base condition: Current studies	Existing Programs:	1. Survival rates	This monitoring action	CHIN1.1

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>and knowledge about survival of juvenile covered fish in the Delta and the Yolo bypass.</p> <p>Approach: Conduct routine mark-recapture and/ or radio-telemetry tagging experiments by marking juvenile covered species near the Fremont Weir within the Yolo bypass and measuring survival and growth rates at Chipps Island</p> <p>Schedule: annually mark and radio-tag individual covered species for at least 5 years. Repeat mark-recapture monitoring every 5th year</p>	<p>IEP mid-water trawl at Chipps Island, previous salmon survival studies (Perry et al 2009)</p> <p>Potential Program Additions:</p> <p>1. routine radio-tracking and/or mark recapture program</p>	<p>2. Species</p>	<p>provides information on the effectiveness of modifying the operations of Fremont weir to benefit survival and growth rates of juvenile outmigrating covered species.</p> <p>The implementing Office will use this information to determine if operation of the Fremont weir is achieving target levels of survival and growth. The information will also serve as a basis to determine if additional research should be conducted, and if initial models and hypotheses are supported by monitoring data.</p> <p>The monitoring schedule may be extended if survival and growth data are inconclusive to determine that survival and growth has achieved target levels or of substantial environmental variability has increased the level of uncertainty associated with predicted outcomes.</p>	<p>STEE1.1 GRST1.1 WHST1.1 RILA1.2 PALA1.2</p>
<p><i>Monitoring Action CM 2-15: Document Sacramento splittail spawning and spawning success in the Yolo Bypass during periods of Fremont Weir operation.</i></p>				
	<p>[Text to come.]</p>	<p>[Text to come.]</p>	<p>[Text to come.]</p>	<p>SASP1.1 SASP1.2 SASP1.3</p>
<p><i>Monitoring Action CM 2-16: Determine the distribution and abundance of giant garter snake in the Yolo Bypass.</i></p>				

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Base Condition: none Approach: Using accepted survey protocols, conduct randomized, stratified surveys to detect presence of GGS in the Yolo Bypass, especially using known or historic locations as starting points and radiating outwards from there. Schedule: Annual surveys during periods of GGS activity. Continue for at least 5 inundation years. Repeat every 5 years, focusing on verifying presence in previously established occurrences.</p>	<p>Existing Programs: historical surveys, research projects, approved sampling protocols. Potential Program Additions: 1. Standardized surveys for Giants Garter Snake 3. Establishment of new sampling points/grids/stations as habitat patches are restored and populations expand See Monitoring Action CM4-8 , 4-14</p>	<p>1. Presence and sex/age distribution of Giant Garter Snake 2. Estimated population trend Giant Garter Snakes in restored habitats (source or sink?)</p>	<p>This monitoring action is intended to collect data on the distribution and population trend of giant garter snake in the Yolo Bypass. Monitoring results will be used to determine if habitat restoration has a source or sink effect on the abundance of giant garter snake in the Yolo Bypass This information is necessary to determine if adaptive changes to the implementation schedule or additional measures may be necessary to increase the abundance and viability of giant garter snake populations in the Yolo Bypass</p>	<p>TANC1.1 FMNC1.1 FMNC2.1 NANC2.1 NWNC2.1 ALNC1.2 ALNC1.5 ALNC1.7 ALNC1.8 GGSN1.1 GGSN2.1</p>
<p><i>Monitoring Action CM 2-17: Determine abundance of wintering waterfowl and shorebirds in the Yolo Bypass during years the Fremont Weir is operated.</i></p>				
<p>Base Condition: Current waterfowl monitoring as conducted by USFWS, CDFG and CWA Approach: Continue USFWS and CDFG special fall and midwinter aerial surveys. The midwinter survey, the longest running population assessment, focuses on all ducks, geese, swans, and coots.</p>	<p>Existing Programs: USFWS midwinter waterfowl surveys Potential Program Additions: none</p>	<p>1. Number 2. Species 3. sex/age composition (if possible)</p>	<p>This monitoring action provides information on the abundance of wintering waterfowl. The Implementation office will use this information to determine the effectiveness of inundation of the Yolo bypass ion providing wintering habitat for waterfowl. The Monitoring schedule may</p>	<p>MWNC1.1 MWNC1.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Schedule: Annual mid-winter surveys as currently implemented by USFWS.</p>			<p>be changed if necessary to improve accuracy and/or precision of waterfowl estimates.</p>	
<p>CM3: Preserve Natural Communities</p>				
<p><i>Action CM3-1 Record the acquisition or protection of parcels by conservation zone, natural community, and covered species habitat.</i></p>				
<p>Base Condition: Pre-acquisition parcel information.</p> <p>Approach: Document and record in a suitable database the characteristics of protected land as they are added to the conservation lands system</p> <p>Schedule: Update maps and database of conservation lands annually to reflect status of each parcel as they are added to the conservation land system.</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions: 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab)</p>	<p>Acres of land protected by Conservation Zone / ROA and natural community</p> <p>Linear miles of edge within tidal mudflat habitats as habitat for tidal-mudflat associated species (e.g., Delta tule pea, Suisun marsh aster)</p>	<p>This monitoring action will provide the means to track how the Implementing Office is adding conservation lands in each Conservation Acquisition zone.</p> <p>This information will be used to assess progress and determine if conservation targets in each CAZ and natural community have been met.</p>	<p>ECSY6.1 ECSY6.2 GRNC1.1 VPNC1.1 ALNC1.1-1.6</p>
<p><i>Monitoring Action CM 3-2: Record, quantify and delineate occurrences of covered plant species.</i></p>				
<p>Base Condition: Pre-acquisition parcel information. Baseline survey of parcels at acquisition</p> <p>Approach: Document and record in a suitable database the characteristics of rare species occurrences on BDCP protected lands</p> <p>Schedule: Survey once every 5 years to document presence and condition/abundance of special status plants</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions: 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Special status surveys and species verifications by a qualified botanist</p>	<p>Species occurrences: 1. Location 2. Species 3. Habitat 4. Number of individuals 5. Land use 6. Threats</p>	<p>This monitoring action will provide information on the presence and status of special-status plants on conservation lands within the BDCP Plan Area.</p> <p>This information will be used in the development of specific management plans for each parcel to ensure that management and protection activities are compatible with special-status plants and these</p>	<p>ALMV1.1 AWNC1.1 CAGB1.1 CFTR1.1 DEBC1.1 HART/ BRIT1.1 HEPE1.1 SOBB1.1 SUTH1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			<p>plants are protected and maintained.</p> <p>The monitoring schedule will be altered for species that are dependent on specific climatic events or conditions (i.e. vernal pool plans require “wet” years to emerge)</p>	
<i>Monitoring Action CM 3-3: Document habitat connectivity among the various BDCP conservation land units in the conservation land system.</i>				
<p>Base Condition: Pre-acquisition parcel information. Baseline documentation</p> <p>Approach: Document and record in a suitable database evidence of connectivity and movement of animals and plants across conservation land habitats.</p> <p>Schedule: Update maps and database of conservation lands annually to reflect the conservation status of adjacent lands and the location of newly arriving species of interest.</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 	<p>Land status and changes in natural communities on adjacent parcels</p> <p>Species occurrence of newly arriving species</p> <p>Observed shifts in species distribution and use of the parcel.</p>	<p>This monitoring action will identify how well the protected lands are connected with adjacent habitats to enable species to move across the landscape.</p> <p>This information will be used to determine where uncertainties and knowledge gaps exists regarding the connectivity of habitats within the BDCP Plan Area, and where corridors for covered and invasive species exist. This information will be used to determine appropriate management strategies to support covered species and reduce the likelihood of dispersal of non-native invasive species.</p> <p>The monitoring schedule may be reduced to every 5 or even 10 years once conservation</p>	<p>ECSY8.1 ECSY9.1 ALNC1.7 VRNC2.3</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			targets have been met within a Conservation Zone.	
Natural Community-Level Conservation Measures				
CM4: Tidal Habitat Restoration				
<i>Monitoring Action CM4-1. Document the extent of tidal habitat restored.</i>				
<p>Base Condition: As-built construction drawings.</p> <p>Approach: Delineate the extent of subtidal aquatic, unvegetated mudflat, vegetated marsh plain by vegetation type, and transitional upland by vegetation type.</p> <p>Schedule: Annually delineate habitat components for the first 5 years following reestablishment of tidal flow and every 5 years thereafter.</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (aquatic botanist) <p>See Monitoring Action CM4-2, CM16-1</p>	<ol style="list-style-type: none"> 1. Extent, distribution, and channel order of tidal perennial aquatic natural community on restoration sites. 2. Percentage of subtidal aquatic habitat in areas of subsidence 3. Extent, distribution and persistence of high-functioning tidal mudflat community 	<p>This monitoring action provides information regarding the development of restored habitat components over time.</p> <p>Results will be used to evaluate if targets and objectives have been met, parameterize and evaluate conceptual models and other analytical tools, and to prioritize potential actions according to certainty, magnitude and timeliness of benefit. This information will also provide the basis for determining if there is a need to modify subsequent restoration designs to improve their ecosystem and habitat functions, or if it is necessary to alter management actions to support the development of desired habitat functions (e.g., control of non-native vegetation, planting of native emergent vegetation to improve development of marsh functions).</p> <p>The monitoring schedule may be adjusted for a particular</p>	<p>ECSY4.1 TANC1.1 BMNC1.1 FMNC1.1 MFNC1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	
<i>Monitoring Action CM4-2. Document the progress of vegetation community establishment and the extent of covered species habitat provided by restored tidal habitats.</i>				
<p>Base Condition: As-built construction drawings.</p> <p>Approach: For the first 5 years following completion of tidal marsh restoration projects, annually conduct aerial and/or field surveys in October to map the extent of tidal vegetation establishment. Evaluate and quantify the extent of each covered species habitat based on evaluation of data collected under Monitoring Action CM4-1.</p> <p>Schedule: Annually quantify the extent of restored covered, species habitats for the first 5 years following reestablishment of tidal flow and every 5 years thereafter.</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (aquatic botanist/ field personnel; see Monitoring Action CM4-1, CM16-1) 	<ol style="list-style-type: none"> 1. Extent, distribution and persistence of high-functioning tidal mudflat community 2. Linear extent of restored or created tidal mudflat substrate as part of the restored brackish and freshwater tidal habitat and channel margin enhancement. 3. Acres of covered species habitat 4. presence of key habitat correlates and requisites/attributes for covered species 5. Percent absolute and relative cover 6. Extent, distribution, cover, and species composition of non-native invasive species within establishing tidal mudflats on restoration sites 	This monitoring action is intended to provide information regarding the development of habitat covered species in restored tidal habitats over time. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	BMNC1.1 FMNC1.1 MFNC1.1 SOBB1.1 SUTH1.1
<i>Monitoring Action CM4-3. Quantify the primary production exported from restored tidal marsh plain into adjacent restored subtidal aquatic habitat areas.</i>				
<p>Base Condition: Seasonal abundances of phytoplankton and</p>	<p>Existing Programs: Environmental Monitoring Program (EMP, under IEP)</p>	<ol style="list-style-type: none"> 1. Phytoplankton species composition/relative 	This monitoring action is intended to collect data	ECSY2.1 TANCI.1

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>zooplankton in channels adjacent to restoration sites. Sample restored subtidal prior to breaching of levees, measured for at least one year prior to restoring tidal habitat.</p> <p>Approach: Establish monitoring stations at inflow and outflow locations and within restored subtidal habitat. Take weekly grab samples and measurements of chlorophyll a and zooplankton.</p> <p>Schedule: Conduct sampling for the first 5 years following reestablishment of tidal flow and every 5 years thereafter.</p>	<p>Potential Program Additions:</p> <p>1. Additional sampling stations in connection with restored tidal marsh plains to reflect the before-after-control-impact design. Locations of some added stations will be fixed during the duration of the plan (systemwide monitoring to detect increase on food availability in delta waterways), others are added as levees are breached and sites are flooded to track how food production in individual wetlands develops over time (i.e., flux from wetland restoration sites)</p> <p>Sampling stations will also provide water quality data (e.g., temperature, turbidity, pH for ammonia conversion, amount of organic carbon)</p> <p>Invertebrate sampling should be adaptively adjusted to changes in fish diets – see also: Monitoring Action CM4-4, CM4-6, and CM16-5</p>	<p>abundance</p> <p>2. Phytoplankton density (mg/L chlorophyll a)</p> <p>3. Zooplankton species composition/relative abundance</p> <p>4. Zooplankton density (number/1,000 m³)</p>	<p>necessary to determine and quantify the degree to which restored tidal habitats are producing and exporting phytoplankton and zooplankton into restored subtidal habitats.</p> <p>This information, in combination with evaluation of other foodweb-related monitoring and research data, will provide the basis for :</p> <p>1. Identifying sources of uncertainty and the design of management experiments and/ research studies, to address uncertainty.</p> <p>2. evaluating underlying conceptual models and hypotheses (source-sink dynamics, variability and uncertainty in primary production response)</p> <p>3. evaluating restoration design options to increase the production and export of primary production from restored tidal marsh plains</p> <p>4. Implementing additional management actions to improve production and export of primary production from</p>	<p>BMNC1.1 FMNC1.1 DESM1.2 LOSM1.3 SASP1.2 CHIN1.1 STEE1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			restored tidal marsh plains The monitoring schedule will be modified if uncertainty or variances do not support a clear causal relationship between tidal marsh restoration and food production and exports. The intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	
<i>Monitoring Action CM4-4. Document the export of organic carbon produced in restored tidal marsh plain into existing Plan Area channels.</i>				
<p>Base Condition: Not applicable.</p> <p>Approach: Determine the extent of organic carbon produced in restored tidal marsh plains that is exported from restored tidal habitats to downstream locations either through modeling (e.g., particle tracking modeling) or direct observation (e.g., isotope marking).</p> <p>Schedule: To be determined based on an assessment of the sufficiency of phytoplankton and zooplankton production levels determined under CM4-3. Conduct once to establish the extent of organic carbon that is exported and repeat as needed if hydrodynamic conditions change sufficiently in the future such that export rates might be affected.</p>	<p>Existing Programs: Environmental Monitoring program (EMP, under IEP)</p> <p>Potential Program Additions: See Monitoring Action CM4-3.</p> <p>1. Possible adaptive expansion of the monitoring program to include isotope particle marking and tracking to determine organic carbon exports downstream locations</p>	<p>1. Amount of organic carbon produced in restored tidal marsh</p> <p>2. Proportion of total organic carbon produced in restored tidal marsh plain that is exported to specified downstream locations.</p>	<p>This monitoring action is intended to collect complimentary and additional data necessary to determine if and how much restored tidal habitats are producing and exporting phytoplankton and zooplankton to downstream locations.</p> <p>This monitoring is an adaptive contingency monitoring action in case actions under CM-4 suggest a high degree of uncertainty or suggest inadequacy of conceptual models.</p> <p>This monitoring action will be implemented as targeted research project to address</p>	ECSY2.1

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			uncertainty in food production pathways and the magnitude and dynamics of exports into Delta water ways. It will be adaptively applied to sites, seasons and identified portions of the Delta.	
<i>Monitoring Action CM4-5. Determine the extent of covered fish species habitat restored by life stage.</i>				
<p>Base Condition: Not applicable.</p> <p>Approach: Based on the current understanding of life stage requirements of each covered fish species and key environmental correlates, delineate the extent of habitat restored for each covered species life stage based on bathymetry (determined from as-build drawings), substrate (assessed before levee breaching), and water quality parameters determined through CM-11.</p> <p>Schedule: Annually for the first 10 years and every 5 years thereafter.</p>	<p>Existing Programs: Current knowledge on life history and biology of covered fishes in the Delta, life history models.</p> <p>Potential Program Additions: 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab)</p>	<ol style="list-style-type: none"> 1. Extent of restored habitat 2. extent of spawning habitat 3. extent of rearing habitat 4. portion of restored habitat within migration routes/corridors 	<p>This monitoring action will provide information on the amount of habitat that is being restored through BDCP conservation measures and how it pertains to requirements for stage-specific life history events of covered species. The implementing Office will use this information to determine if restored habitat effectively addresses habitat limitations.</p> <p>The monitoring action will be intensified if modeling or field observations suggest that certain habitats are in short supply and that restoration and protection targets should be modified through the adaptive decision making process.</p>	<p>DESM1.1 LOSM1.1 CHIN1.1 STEE1.1 SASP1.1 GRST1.2 WHST1.2 RILA1.1 PALA1.1</p>
<i>Monitoring Action CM4-6. Determine covered fish species use of restored subtidal aquatic habitat.</i>				
<p>Base Condition: Estimated existing seasonal abundances of relevant life stages of covered fish species in channels adjacent to restoration sites based on existing</p>	<p>Existing Programs: IEP –coordinated fish surveys: 1. CDFG 20 mm Survey 2. CDFG Delta smelt larva study 3. USFWS Spring Kodiak Trawl and</p>	<ol style="list-style-type: none"> 1. Seasonal distribution of covered fish species 2. Type of use (e.g., rearing, spawning) 3. Duration of use 	<p>This monitoring action will provide information to determine and quantify use of restored subtidal aquatic habitat by covered fish species.</p>	<p>DESM1.1 LOSM1.1 CHIN1.1 STEE1.1 SASP1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>information (IEP fish sampling).</p> <p>Approach: Conduct surveys for each covered fish species using standardized existing or improved methods.</p> <p>Schedule: Conduct sampling for the first 5 years following reestablishment of tidal flow and at least every 5 years thereafter.</p>	<p>“Supplemental Surveys”, Mossdale trawl</p> <ol style="list-style-type: none"> 4. USFWS Midwater trawl 5. USFWS beach seine 6. CDFG Summer townet survey 7. UCD/IEP Suisun Marsh otter trawl <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Expanded sampling location array to reflect changed food availability, diversion and flow regimes (e.g., North delta and Ship Channel); additional sampling areas should be located near restored subtidal habitat to determine fish response to restored habitats. Stratify sampling by project and systemwide variables. 	<ol style="list-style-type: none"> 4. species, age composition and sizes of covered fish species 5. CPUE 	<p>This information in combination with evaluation of other covered fish species-related monitoring and research data, will be used to evaluate underlying models and hypotheses about the predicted benefits of restored subtidal aquatic habitat to covered fish species.</p> <p>This information will aid in identifying sources of uncertainty and will guide the design of further management experiments and/ research studies to address uncertainty.</p> <p>The Implementing Office will use this information to evaluate restoration design options and additional management actions to increase the benefits of restored tidal marsh plains to covered species.</p> <p>The monitoring schedule and methods may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and</p>	<p>GRST1.2 WHST1.2 RILA1.1 PALA1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<i>Monitoring Action CM4-7. Determine nonnative fish species use of restored subtidal aquatic habitat.</i>				
<p>Base Condition: Estimated existing seasonal abundances of relevant life stages of nonnative fish species in channels adjacent to restoration sites based on existing information (IEP fish sampling).</p> <p>Approach: Conduct surveys for nonnative fish species using standardized existing or improved methods.</p> <p>Schedule: Conduct sampling for the first 5 years following reestablishment of tidal flow and at least every 5 years thereafter.</p>	<p>Existing Programs: IEP –coordinated fish surveys:</p> <ol style="list-style-type: none"> 1. CDFG 20 mm Survey 2. CDFG Delta smelt larva study 3. USFWS Spring Kodiak Trawl and “Supplemental Surveys”, Mossdale trawl 4. USFWS Midwater trawl 5. USFWS beach seine 6. CDFG Summer townet survey 7. UCD/IEP Suisun Marsh otter trawl <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Expanded sampling location array to reflect changed food availability, diversion and flow regimes (e.g., North delta and Ship Channel); additional sampling areas should be located near restored subtidal habitat to determine fish response to restored habitats. Stratify sampling by project and systemwide variables. 	<ol style="list-style-type: none"> 1. Seasonal distribution of covered fish species 2. Type of use (e.g., rearing, spawning) 3. Duration of use 4. species, age composition and sizes of covered fish species 5. CPUE 	<p>This monitoring action will provide information to determine and quantify use of restored subtidal aquatic habitat by nonnative fish species.</p> <p>This information in combination with evaluation of other non-native fish species-related monitoring and research data, will be used to evaluate underlying models and hypotheses about the predicted use of restored subtidal aquatic habitat by nonnative fish species.</p> <p>This information will aid in identifying sources of uncertainty and will guide the design of further management experiments and/ research studies to address uncertainty.</p> <p>The Implementing Office will use this information to evaluate restoration design options and additional management actions to minimize the use of restored tidal marsh plains to nonnative species.</p> <p>The monitoring schedule and methods may be adjusted for a</p>	<p>ECSY3.1 GEFC1.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	
<i>Monitoring Action CM4-8. Determine the extent of nonnative submerged (SAV) and floating aquatic vegetation (FAV) in subtidal aquatic habitats.</i>				
Implemented through Monitoring Action CM13-1. Also see Monitoring Action SY 5-2. Determine the abundance and species composition of non-native, submerged and floating aquatic vegetation (Table 3.12)				ECSY3.1 GEFC1.2
<i>Monitoring Action CM4-9. Determine the extent and patterns of establishment of nonnative clams in restored subtidal aquatic habitats.</i>				

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Base conditions: ongoing benthic monitoring by IEP throughout the Estuary.</p> <p>Approach: Benthic monitoring will be conducted at up to 20 sites within the estuary, with four benthic samples and one sediment sample taken at each site. Samples are analyzed by a contracting lab. Samples will be collected using a hydraulic winch and Ponar dredge or other appropriate grab sampler.</p> <p>Schedule: Quarterly</p>	<p>Existing Programs: Benthic monitoring component of IEP’s Environmental Monitoring Program (EMP)</p> <p>Potential Program Additions: Increase the number of benthic sampling stations to up to 20 sites as a representatively sample of the entire BDCP plan area.</p> <p>Database to track observation and incidental records of non-native bivalves to estimate their habitat use and range expansion in the Delta</p>	<ol style="list-style-type: none"> 1. Species of non-native bivalves 2. Total number of individuals counted 3. Size distribution of clams 	<p>This monitoring activity provides information on the non-native clams of the estuary, changes in their presence, abundance and distribution. Data collected from the benthic monitoring program is also used to detect newly introduced species in the estuary. The Implementing Office will use this information to determine the status and change of benthic communities over the term of the BDCP and to evaluate possible causal relationships between physical factors and benthic invertebrate communities.</p> <p>This information will also provide important indicators of invasive species progress, impacts of toxics and water operations, and other changes within the Delta. The monitoring schedule may be adjusted to provide data at a higher temporal or spatial resolution of deemed necessary.</p>	<p>DESM1.1 ECSY3.1</p>
<p><i>Monitoring Action CM4-10. Determine the extent and patterns of establishment of Microcystis in restored subtidal aquatic habitats</i></p>				
<p>Base Condition: existing data on Delta microcystis abundance, productivity and correlations with water quality parameters</p>	<p>Existing Programs: Environmental Monitoring Program (EMP, under IEP)</p> <p>Potential Program Additions: 1. Locations of added stations will be fixed</p>	<ol style="list-style-type: none"> 1. Phytoplankton species composition/relative abundance 2. Phytoplankton density (mg/L chlorophyll a) 	<p>This monitoring action is intended to collect data necessary to determine and quantify the degree of microcystis spread and toxic</p>	<p>ECSY3.1 GECF1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Approach: Establish additional fixed monitoring stations as needed in areas where microcystis blooms are observed or likely to occur given water conditions. Take weekly grab samples and measurements of chlorophyll a.</p> <p>Schedule: Conduct sampling for the first 5 years following first detection and every 5 years thereafter.</p>	<p>during the duration of the plan to detect increase on microcystis abundance and blooming activity in delta waterways Sampling stations will also provide water quality data (e.g., temperature, turbidity, pH for ammonia conversion, amount of organic carbon)</p> <p><i>See Monitoring Actions CM 4-3, CM4-4, CM4-6, and CM16-5</i> <i>See Monitoring Actions 5-3 (Table 3.12)</i></p>	<p>3. microcystis colony structure</p> <p>4. Water temperature</p> <p>5. NH₄⁺ concentration</p> <p>6. EC</p> <p>7. presence of non-native clams (see SY5-3)</p>	<p>blooms in the Delta.</p> <p>This information, in combination with evaluation of other foodweb-related monitoring and research data, will provide the basis for :</p> <p>1. Identifying sources of uncertainty and the design of management experiments and/ research studies, to address uncertainty.</p> <p>2. evaluating underlying conceptual models and hypotheses (e.g., excessive N loading . grazing effects by clams, salinity and temperature limiting factors)</p> <p>3. evaluating restoration design options to increase the production and export of primary production inundated floodplains</p> <p>4. Implementing additional management actions to improve production and export of primary production from the floodplain.</p>	
<i>Monitoring Action CM4-11. Determine water quality conditions for covered fish species in restored subtidal aquatic habitats.</i>				
Base Condition: Existing	Existing Programs:	1. Water temperature (°C)	This monitoring action is	DESM1.3

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>seasonal water quality conditions in channels adjacent to restoration sites based on existing information (see Applicable IEP and other Resources). Upon breaching, establish base conditions by paired sampling within restored habitat and at outflow channel locations.</p> <p>Approach: Establish water quality sampling stations in restored subtidal habitat area. Monthly, collect and analyze water grab samples at representative depths for: 1) water temperature, 2) dissolved oxygen, 3) turbidity, 4) salinity, 5) ammonia and 6) methylmercury.</p> <p>Schedule: Sample monthly for 1) the first 2 years following reestablishment of tidal flow, 2) quarterly for the following 10 years, 3) and quarterly every 5 years thereafter.</p>	<p>1. Continuous Multiparameter Monitoring, Discrete Physical /Chemical Water Quality Sampling (Environmental Monitoring program; IEP)</p> <p>2. Continuous Recorder Sites (DWR, USBR)</p> <p>3. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program (Central Valley Water Board)</p> <p>4. Delta Flows Network and National Water Quality Assessment Program (USGS)</p> <p>5. other (DWR, SRCSD, SWAMP, Central Valley Water Board, State Water Board, SFEI, etc)</p> <p>Potential Program Additions:</p> <p>1. There are over 100 water quality sampling sites within the Delta providing a baseline of water quality data. If needed, additional localized sampling stations may be added to reflect the before-after-control-impact design (grab samples in project locations). Locations of some stations will be added as levees are breached and sites are flooded to track water quality changes at restoration sites.</p>	<p>2. mg/L dissolved oxygen</p> <p>3. Turbidity (NTUs)</p> <p>4. Salinity (EC)</p> <p>5. pH</p> <p>6. mg methylmercury/L</p>	<p>intended to collect data necessary to determine if water quality conditions in restored tidal marshes are suitable for supporting covered fish species. It will also be used to determine the possible impact on water quality in adjacent channels and habitats.</p> <p>This information will be used to evaluate underlying models and hypotheses of water quality responses to tidal marsh restoration.</p> <p>This information will aid in identifying sources of uncertainty and will guide the design of further management experiments, design modifications and/ research studies to address uncertainty.</p> <p>The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.</p>	<p>DESM1.4 LOSM1.2 CHSA1.3 GRST1.3 GRST1.4 WHST1.3 WHST1.4 RILA1.5 PALA1.5</p>
<p><i>Monitoring Action CM4-12. Determine the response and status of salt marsh harvest mouse, Suisun shrew, Suisun song sparrow, and California clapper rail, California black rail to loss of existing Suisun Marsh habitats that are restored as tidal habitat.</i></p>				

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Base Condition: The existing distribution and abundance of Suisun Marsh covered mammal and bird species based on existing information and additional surveys if needed.</p> <p>Approach: Conduct surveys, transects, mark-recapture or other methods to evaluate the response and status of Suisun Marsh populations of covered mammal and bird species following the conversion of existing species habitat areas to tidal habitat. Map upland refugia during high tide events, survey for presence/use of salt marsh harvest mouse during high tide</p> <p>Schedule: Conduct at least annual sampling of covered species distribution and abundance for 5 years following each tidal habitat restoration project until use of restored tidal habitats by covered mammal and bird species is established.</p>	<p>Existing Programs: IEP’s Suisun marsh program (triennial vegetation surveys, GIS map identifying 103 vegetation classifications, change detection analysis, Salt Marsh Harvest Mouse Monitoring program on Conservation Areas), Point Reyes Bird Observatory (PRBO) San Francisco Bay Tidal Marsh Project, some historic surveys, research projects, approved sampling protocols.</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Regular mark-recapture program for SMHM and Suisun shrew (trapping grids) in Suisun marsh 2. Standardized surveys for Clapper rail, Suisun song sparrow and black rail (using PRBO San Francisco Bay Tidal Marsh Project protocols as appropriate) 3. Establishment of new sampling points/grids/stations as habitat patches are restored <p>See Monitoring Action CM4-9</p>	<ol style="list-style-type: none"> 1. Abundance (N) of each species in Suisun Marsh 2. Population trend (λ) of each species in Suisun Marsh 3. Distribution and range of each species in Suisun Marsh 4. Extent and distribution of upland refugia for salt marsh harvest mouse during high tide. 	<p>This monitoring action is intended to test the hypothesis that restoring tidal marshes will have no effect on the status and population size of covered species in Suisun Marsh.</p> <p>Monitoring results will be used to determine how much habitat restoration has affected the distribution and abundance of Suisun Marsh covered mammal and bird species.</p> <p>This information is necessary to determine if adaptive changes to the implementation schedule (i.e., timing and extent of tidal habitat restoration projects in Suisun Marsh) are necessary to maintain viability of covered species populations in Suisun Marsh.</p> <p>Monitoring frequency and intensity may be adjusted to provide monitoring that addresses uncertainties effectively.</p>	<p>TANC1.1 BMNC1.1</p>
<p><i>Monitoring Action CM4-13. Determine covered wildlife species use of restored tidal habitats in Suisun Marsh.</i></p>				
<p>Base Condition: The existing distribution and abundance of covered marsh-associated wildlife species in Suisun Marsh based on existing information and</p>	<p>Existing Programs: IEP’s Suisun marsh program, some historic surveys, research projects, approved sampling protocols.</p>	<ol style="list-style-type: none"> 1. Estimated abundance of each species in using restored habitat 2. estimated populations 	<p>This monitoring action is intended to collect data on the distribution and population trend of covered species in Suisun Marsh restored habitats.</p>	<p>ECSY6.5 TANC1.1 MFNC1.1 MFNC1.2 BMNC1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>additional surveys if needed. Not applicable to restoration sites in the Delta.</p> <p>Approach: Conduct standardized surveys using established methods to determine the abundance and type of use (e.g., foraging, nesting) of marsh plain and transitional upland habitats by covered wildlife species. Conduct standard vegetation transects and monitoring of incidental reports of newly established clones of covered plants, tracking of growth, survival and cover of covered plant species.</p> <p>Schedule: Conduct surveys for each species during each species' active period for 5 years following the development of habitat functions for each species as determined through data collected under CM4-2 and every 5 years thereafter.</p>	<p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Intensive mark-recapture program for SMHM and Suisun shrew in Suisun marsh 2. Standardized surveys (breeding, winter) for Clapper rail, Suisun song sparrow and black rail 3. standard surveys of covered plant species 3. Establishment of new sampling points/grids/stations as habitat patches are restored and populations expand <p>See Monitoring Action CM4-8</p>	<p>trend in restored habitats (source or sink?)</p> <p>3. Presence and population size of covered plant species (e.g., bird's beak, Mason's lilaeopsis, Delta mudwort, Delta tule pea Slough thistle, and Suisun Marsh aster)</p>	<p>Monitoring results will be used to determine if habitat restoration has a source or sink effect on the abundance of Suisun Marsh covered mammal and bird species</p> <p>This information is necessary to determine if adaptive changes to the implementation schedule (i.e., timing and extent of tidal habitat restoration projects in Suisun Marsh) are necessary to maintain populations of these covered species in Suisun Marsh and to increase the utility of restored habitats to covered species</p>	<p>BMNC2.1</p>
<p><i>Monitoring Action CM4-14. Determine covered wildlife species use of restored tidal habitats in the Delta.</i></p>				
<p>Base Condition: The existing distribution and abundance of covered marsh-associated wildlife species, specifically giant garter snake (Conservation Zone 4 and 5), western pond turtles, and California least tern foraging sites.</p> <p>Approach: Conduct standardized</p>	<p>Existing Programs: historical surveys, research projects, approved sampling protocols.</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Standardized surveys for Giants Garter Snake, western pond turtles and California least tern 	<ol style="list-style-type: none"> 1. Presence and sex/age distribution of Giant Garter Snake 2. Presence and sex/age distribution of western pond turtles 3. Estimated populations trend of covered species in 	<p>This monitoring action is intended to collect data on the distribution and population trend of covered species in restored habitats.</p> <p>Monitoring results will be used to determine if habitat restoration has a source or sink effect on the abundance of</p>	<p>ECSY6.5 TANC1.1 MFNC1.1 MFNC1.2 BMNC1.1 BMNC2.1 FMNC1.1 FMNC2.1 GGSN1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>surveys using established methods to determine the abundance and type of use (e.g., foraging, nesting) of marsh plain and transitional upland habitats by covered wildlife species. Conduct standardized surveys using established methods to determine the abundance and type of use (e.g., foraging, nesting) of Giant Garter snake (Conservation Zone 4 and 5), western pond turtles, and California least tern sites.</p> <p>Schedule: Conduct surveys for each species during each species' active period for 5 years following the development of habitat functions for each species as determined through data collected under CM4-2 and every 5 years thereafter.</p>	<p>3. Establishment of new sampling points/grids/stations as habitat patches are restored and populations expand</p> <p>See Monitoring Action CM4-8</p>	<p>restored habitats (source or sink?)</p>	<p>covered mammal and bird species.</p> <p>This information is necessary to determine if adaptive changes to the implementation schedule (i.e., timing and extent of tidal habitat restoration projects) are necessary to maintain populations of these covered species and to increase the utility of restored habitats to covered species.</p>	<p>GGSN2.1</p>
<p>CM5: Seasonally Inundated Floodplain Restoration</p>				
<p><i>Monitoring Action CM 5-1: Develop inundation rating curves to quantify the relationship between discharge and inundation dynamics of floodplain habitat for covered species.</i></p>				
<p>Base condition: As-built restored habitat elevations and river stage elevations.</p> <p>Approach: The Implementing Office will develop inundation rating curves for inundation depth and extent of restored inundated floodplain habitat area and will record floodplain inundation events and period of inundation</p>	<p>Existing Programs: California Bay Delta Authority Science Program - Integrated Regional Wetlands Monitoring (historic pilot program)</p> <p>Potential Program Additions:</p> <p>1. Installation and monitoring of automated monitoring devices or other appropriate measures to determine inundation depth, stage and frequency.</p>	<p>1. Inundation frequency 2. Inundation duration</p>	<p>This monitoring element will provide information on the relationship between inundation depth and inundation period and extent to guide the design of floodplain projects and/or operation of flood control structures.</p> <p>This information will be used to guide and if necessary,</p>	<p>CHIN1.1 STEE1.1 SASP1.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>by automatic water depth monitoring gages and other appropriate methods.</p> <p>Schedule: monitoring of inundation depth and extent of inundated area will continue until a sufficient inundation rating curve can be established with reasonable uncertainty.</p>			<p>change the design of floodplain restoration projects and if applicable, the operation of flood control structures to effectively control the period of inundation in seasonal floodplains under an variable flow regimes.</p> <p>The monitoring schedule may be adjusted in response to uncertainty of the established ratings curve.</p>	
<p><i>Monitoring Action CM5-2: Record and quantify incidences and locations of stranded covered fish species at the end of the inundation period in restored floodplains.</i></p>				
<p>Base Condition: none</p> <p>Approach: Visual and other surveys (e.g., beach seining) immediately following inundation periods in restored floodplain habitats as flows are receding from the floodplain to document stranding locations and magnitude.</p> <p>Schedule: Annual surveys for the first five years after restoration. Once documented, monitoring will be discontinued and a more limited monitoring effort to be determined by the Implementing Office would be conducted every 5th year that restored floodplains are inundated to document any changes in stranding location and magnitude that may result from changes in floodplain topography</p>	<p>Existing Programs: Intermittent and historical IEP and USFWS beach seine and trawling methods within the Yolo and Sutter bypasses</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Weekly surveys of restored floodplains to identify areas suddenly dewatered by lower river conditions which may contain stranded fish. 2. Follow-up on the ground, dip netting, beach seining or electro-shocking of remnant puddles to verify stranding. On-the-ground mapping of standing locations to guide re-contouring. 	<ol style="list-style-type: none"> 1. locations of covered fish species stranding 2. number, species, length, and age/sex distribution of stranded fish 3. type of stranding pool (i.e., erosion, topography, man-made, etc.) 	<p>This monitoring action will provide information on the extent and magnitude of fish strandings at the end of the inundation period in restored floodplains.</p> <p>This information will be used to determine the severity of fish stranding and their locations within the restored floodplain. Results of monitoring will be used to determine if modifications to floodplain surfaces are needed to reduce stranding risk (e.g., grading).</p> <p>The schedule of the monitoring action may be adjusted to reflect changes in management. In locations where floodplain topography was altered to</p>	<p>CHIN1.1 STEE1.1 SASP1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
(e.g., formation of scour holes or sedimentation that create isolated pools).			reduce fish stranding, monitoring will continue for at least 3 years to document reduction in stranding incidences.	
<i>Monitoring Action CM5-3. Quantify presence and abundance of juvenile salmonids in restored floodplain habitats during inundation periods.</i>				
<p>Base Condition: Concurrent presence and abundance of juvenile salmonids in adjacent Delta waterways</p> <p>Approach: Visual and non-lethal fish sampling (e.g., beach seining, electrofishing) of representative, randomly selected sections of restored floodplain habitats during the inundation period and in adjacent Delta waterways.</p> <p>Schedule: During the first 5 floodplain inundation events that coincide with rearing/outmigration periods of juvenile salmonids, conduct biweekly sampling of the inundated floodplain as long as the floodplain is inundated. Subsequently monitor every fifth flood event over the term of the BDCP.</p>	<p>Existing Programs: Historical sampling, USFWS weekly beach seining survey of juvenile salmonids (49 permanent locations Delta wide)</p> <p>Potential Program Additions:</p> <p>1. Add sampling locations to include restored floodplain and adjacent channel habitats to ensure statistical representative sampling effort</p>	<p>1. Abundance, size, and race of salmonid species in the inundated restored floodplain habitat and in adjacent Delta waterways.</p>	<p>This monitoring action will provide information on the presence and abundance and relative use of restored floodplains compared to adjacent delta waterways.</p> <p>Results of monitoring will be assessed to determine if floodplain habitats attract more salmonids than adjacent waterways and if fish abundance, age and size distributions differ among restored floodplains and adjacent waterways of the Delta. Results will be used to determine if subsequent design or locations of restored floodplains need to be adjusted to improve their function as juvenile salmonid habitat.</p> <p>The schedule of the monitoring action may be adjusted to reflect changes in management or research results on fish presence in inundated floodplains.</p>	<p>CHIN1.1 CHIN1.2 STEE1.1 STEE1.2</p>
<i>Monitoring Action CM5-4: Delineate and quantify Sacramento splittail spawning and rearing in relationship to restored seasonally inundated floodplain habitat.</i>				

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Base condition: Conduct surveys of splittail adults, larvae, and eggs in slow-moving sections of rivers and sloughs and dead-end sloughs adjacent to projected floodplains to determine the abundance of splittail larvae and early juveniles present during the reproductive period.</p> <p>Approach: Conduct fish sampling surveys in restored floodplain habitats and adjacent slow-moving sections of rivers and sloughs and dead-end sloughs during inundation periods to determine the change in densities of larvae and juveniles relative to base conditions and in-channel spawning.</p> <p>Schedule: Weekly fish sampling will be conducted in spawning habitat within restored habitats and in adjacent channel habitats during the first 5 floodplain inundation periods during the splittail spawning season. Subsequently monitor every fifth flood event over the term of the BDCP.</p>	<p>Existing Programs: USFWS rotary screw traps USFWS beach seine</p> <p>Potential Program Additions:</p> <p>1. Add sampling locations to include restored floodplain and adjacent channel habitats to ensure statistical representative sampling effort</p>	<p>1. Production of Sacramento splittail (number of larval and early juvenile splittail/10,000 m³) during floodplain inundation periods</p>	<p>This monitoring action will provide information on productivity of Sacramento splittail populations and the contribution of inundated restored floodplains on spawning and rearing of splittail.</p> <p>This information will be used by the Implementing Office to decide if the production of splittail during floodplain inundation periods has increased significantly from base conditions.</p> <p>If monitoring results do not support conceptual models and hypotheses predicting increasing splittail spawning, the Implementing Office will conduct additional studies to determine</p> <p>1. uncertainties and competing hypotheses 2. other factors/stressors that affect splittail spawning and rearing in restored habitats, and 3. restoration design modifications to increase splittail productivity. If causes are related to inundation duration, experimental management of flood control</p>	<p>SASP1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			<p>structures and floodplain topography may used to address uncertainties.</p> <p>The monitoring schedule may be extended or intensified if uncertainties of causal relationships persist.</p>	
<i>Monitoring Action CM5-5: Quantify abundance of nonnative fish species in restored floodplain habitats during inundation periods.</i>				
<p>Base Condition: Concurrent abundance of nonnative fish species in adjacent Delta waterways</p> <p>Approach: Visual and non-lethal fish sampling (e.g., beach seining, electrofishing) of representative, randomly selected sections of restored floodplain habitats during the inundation period and in adjacent Delta waterways.</p> <p>Schedule: During the first 5 floodplain inundation events that coincide with rearing/outmigration periods of juvenile salmonids, conduct biweekly sampling of the inundated floodplain as long as the floodplain is inundated. Subsequently monitor every fifth flood event over the term of the BDCP.</p>	<p>Existing Programs: Historical sampling, USFWS weekly beach seining (49 locations Delta wide)</p> <p>Potential Program Additions:</p> <p>1. Add sampling locations to include restored floodplain and adjacent channel habitats to ensure statistical representative sampling effort</p>	<p>1. Abundance, size, and race of salmonid species in the inundated restored floodplain habitat and in adjacent Delta waterways.</p>	<p>This monitoring action will provide information on the presence, abundance, and relative use of restored floodplains compared to adjacent delta waterways.</p> <p>Results of monitoring will be assessed to determine if floodplain habitats attract more salmonids than adjacent waterways and if fish abundance, age and size distributions differ among restored floodplains and adjacent waterways of the Delta. Results will be used to determine if subsequent design or locations of restored floodplains need to be adjusted to improve their function as juvenile salmonid habitat.</p> <p>The schedule of the monitoring action may be adjusted to reflect changes in management or research results on fish</p>	<p>ECSY3.1 CHSA1.9 STEE1.8 SASP1.5</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			presence in inundated floodplains.	
<i>Monitoring Action CM5-6: Identify types and quantities of aquatic food production for covered fish species.</i>				
<p>Base Condition: Aquatic food production in adjacent channel habitat prior to restoration activities. Take weekly samples and measurements during inundation period for zooplankton and pelagic macroinvertebrates in Delta waterways adjacent to floodplain restoration sites for a least one year before habitat is restored to establish base conditions.</p> <p>Approach: Sample and measure zooplankton and pelagic macroinvertebrates abundance weekly at inflow, outflow and interior sampling points/transects within restored floodplains during inundation periods, and compare these with in-channel samples of zooplankton and pelagic macroinvertebrates taken in adjacent waterways. Assess measurements of zooplankton and pelagic macroinvertebrates to establish relationships between restored floodplain habitat during inundation periods and production of zooplankton and and pelagic macroinvertebrate forage species for covered fish.</p> <p>Schedule : Once these</p>	<p>Existing Programs: Zooplankton monitoring conducted by Environmental Monitoring Program (EMP under IEP umbrella) also includes monitoring of water quality, benthos, phytoplankton and exotic species</p> <p>Potential Program Additions:</p> <p>1. Additional sampling stations to reflect the before-after-control-impact design. Locations of some added stations will be fixed during the duration of the plan (systemwide monitoring to detect increase on food availability in delta waterways), others are added as levees are breached and sites are flooded to track how food production in individual wetlands develops over time (i.e., flux from wetland restoration sites)</p> <p>Sampling stations will also provide water quality data (e.g., temperature, turbidity, pH for ammonia conversion, amount of organic carbon)</p> <p>Invertebrate sampling should be adaptively adjusted to changes in fish diets – see also Monitoring Action CM4-4 and Monitoring Action CM4-6.</p>	<ol style="list-style-type: none"> 1. Zooplankton species composition/relative abundance 2. Zooplankton density (number/1,000 m³) 3. Pelagic macroinvertebrate species composition / relative abundance 4. Pelagic macroinvertebrate density (number/1,000 m³) 	<p>The monitoring action will provide information to test hypotheses on the role that the restored floodplain plays in providing additional aquatic food resources for covered fish in and outside the restoration areas. The monitoring will provide quantitative assessments to determine how much of this food enters the aquatic system through outflows from the floodplain.</p> <p>This information will be used by the Implementing Office to determine if and how much restored floodplains contribute to increased food availability for covered fish species.</p> <p>This information will be used to guide the development of alternative models, hypotheses, management strategies and additional research studies to resolve uncertainties about hypotheses or models. For example, if production of zooplankton and macroinvertebrates does not exceed production relative to base conditions or is not</p>	<p>ECSY2.1 CHIN1.2 STEE1.2 SASP1.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
relationships have been established, annual monitoring of aquatic food production may be discontinued and a more limited monitoring effort to be determined by the Implementing Office may be conducted every 5 th year to document any changes in zooplankton and macroinvertebrates production during floodplain inundation periods over the term of the BDCP.			trending towards achieving those production levels, the Implementing Office may conduct investigations to determine causes for insufficient production of zooplankton and macroinvertebrates. Depending on the causes, potential actions could include the experimental modification of floodplain surfaces to increase inundation duration or vegetation structure, or installing water control structures at inflow and outflow locations.	
<i>Monitoring Action CM5-7: Document occurrences and abundances of delta button-celery and slough thistle.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	MFNC1.1 MFNC1.2
CM6: Channel Margin Habitat Restoration				
<i>Monitoring Action CM6-1 Extent of channel margin enhanced to provide habitat for covered fish species.</i>				
<p>Base Condition: As-built restoration designs. Baseline documentation for acquired parcels</p> <p>Approach: Extent of enhanced habitat following restoration actions will be delineated, including habitat type (e.g., submerged bench, channel margin emergent vegetation, overhead shaded riverine cover) and</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (aquatic botanist/ field personnel) 	<ol style="list-style-type: none"> 1. Linear feet of enhanced habitat by habitat type 	<p>This monitoring action will provide information about the progress and spatial extent of channel habitat enhancement.</p> <p>This information will be used to determine if subsequent restoration designs can or should be modified to improve habitat conditions for covered fish species. It will also serve to guide and design</p>	<p>MFNC1.1 MFNC1.2 CHIN1.1 STEE1.1 SASP1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
vegetation communities. Schedule: Annually delineate habitat components for the first 5 years following restoration actions.	See Monitoring Action CM4-1, CM4-2, CM6-2)		management actions to increase or maintain enhancement results (see Monitoring Action CM16-2). The monitoring schedule may be adjusted for a particular project in response to monitoring results. The intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	
<i>CM6-2: Quantify the extent and dynamics of establishment of emergent vegetation .</i>				
Base Condition: As-built restoration designs. Targets for the establishment of emergent vegetation as identified in habitat enhancement design specifications for each channel margin enhancement site. Baseline documentation for acquired parcels. Approach: Percent absolute vegetative cover and extent of vegetated channel will be determined in years 1, 2, and 5 following enhancement. Enhancement sites will be monitored at least every 5 years to assess the extent of established non-native invasive vegetation.	Existing Programs: DWR IISS section within DWR-DES Potential Program Additions: 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (aquatic botanist/ field personnel) See Monitoring Action CM4-1, CM4-2, CM6-1)	1. Percent absolute vegetation cover over time 2. Linear extent of vegetated channel margin 3. Presence and extent of non-native invasive vegetation	This monitoring action is intended to provide information regarding the development of habitat structure and vegetation community structure in enhanced channel margin habitats over time. This information will provide the basis for determining if there is a need to modify subsequent enhancement designs to improve the development of emergent vegetation over time. It also may guide development of management actions to improve the establishment of emergent plant communities in enhanced channel margin	FMNC1.1 FMNC2.1 MFNC1.1 MFNC1.2

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			habitats, including additional studies to identify such actions. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.	
<i>CM6-3: Quantify the presence and abundance of covered and nonnative fish species using enhanced channel margin habitats.</i>				
<p>Base condition: If sufficient existing information is not available, conduct monthly fish sampling surveys along existing channel margin habitats to be enhanced for a least one year before enhancement is implemented using appropriate survey methods to be determined by the Implementing Office to establish base conditions.</p> <p>Approach: Following enhancement, initiate comparable surveys within enhanced channel margin habitats and continue surveys</p> <p>Schedule: Continue surveys until a relationship between the abundance of each covered fish species/non-native predatory fish species and the extent and</p>	<p>Existing Programs: fish surveys</p> <ol style="list-style-type: none"> 1. CDFG 20 mm Survey 2. CDFG delta smelt larva study 3. USFWS Spring Kodiak Trawl and 'Supplemental Surveys', Mossdale trawl 4. USFWS Midwater trawl 5. USFWS beach seine 6. CDFG Summer townet survey 7. UCD/IEP Suisun Marsh otter trawl <p>Potential Program Additions: Expanded sampling location array to sampling locations along channel margin and within channel margin habitats. Beach seining to reflect micro-habitats and shallow areas not sampled by trawls. Trawl or townet surveys if channel margin extends too deep for beach seine sampling.</p>	<ol style="list-style-type: none"> 1. Presence of covered fish species by life stage in enhanced channel margin habitats 2. Abundance and length of covered fish species per unit area of habitat 3. Abundance of nonnative fish per unit area of habitat 4. Ratio of nonnative predatory fish to native fish 	<p>This monitoring action will provide quantitative information about the effectiveness of the enhanced channel margins to provide habitat for different life stages of covered fish species and their spatial response (presence and density) to these enhancements.</p> <p>Monitoring results will be used to evaluate if targets and objectives have been met, parameterize and evaluate conceptual models and other analytical tools, and to prioritize potential actions according to certainty, magnitude and timeliness of benefit.</p>	ECSY3.1 CHSA1.9 STEE1.8 SASP1.5 CHIN1.1 STEE1.1 SASP1.1

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>function of enhanced habitat is established (at least 5 years). Subsequently, surveys will be conducted at least every 5 years to document any changes that may occur in use of enhanced channel margin habitats over the term of the BDCP.</p>			<p>The information provided will also support decisions on potential modification of enhancement design and techniques. It will guide management actions to maintain enhanced habitats. It will also be used to determine if additional research activities or special survey technology should be developed.</p> <p>The monitoring schedule may be adjusted if the relationship between the abundance of each covered fish species/non-native predatory fish species and the extent and function of enhanced habitat cannot be established with acceptable certainty over the first 5 years, especially in cases where designs and enhancement techniques are changed through the adaptive management process. In these cases, annual monitoring will continue for 10 years post enhancement, and then be repeated every 5 years.</p>	
<p><i>Monitoring Action CM6-4: Document occurrences and abundances of intertidal covered plant species.</i></p>				
<p>[Text to come.]</p>	<p>[Text to come.]</p>	<p>[Text to come.]</p>	<p>[Text to come.]</p>	<p>FMNC1.1 FMNC2.1 MFNC1.1 MFNC1.2 SOBB1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
CM7: Riparian Habitat Restoration				
<i>Monitoring Action CM7-1. Document the extent of riparian natural communities restored.</i>				
<p>Base Condition: As-built construction drawings.</p> <p>Approach: Delineate the extent of restored riparian habitat by vegetation community type, vegetation structure type, and seral stage; to characterize vegetation structure, measure vegetation attributes such as canopy height, canopy closure, and percent midstory cover. Also measure percent native trees and percent native shrubs</p> <p>Schedule: Annually delineate habitat components for the first 5 years following the implementation of individual riparian restoration projects and every 5 years thereafter.</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) including terrestrial data 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (terrestrial botanist/ field personnel) See also Monitoring Action CM4-1, CM4-2, CM16-1, CM16-2) 	<ol style="list-style-type: none"> 1. Acres of each component of restored riparian habitat. 2. patch length, width 3. % absolute vegetation cover. 4. % relative cover of native plant species. 5. Canopy height 6. Canopy closure 7. % midstory cover 8. % native trees 9. % native shrubs 	<p>This monitoring action is intended to provide information regarding the development of restored riparian habitat components over time. This information will provide the basis for determining if there is a need to:</p> <p>Modify subsequent restoration designs to improve their ecosystem and habitat functions,</p> <p>Undertake management actions to improve development of desired habitat functions (e.g., control of non-native vegetation, planting of native vegetation, improve local hydrology to enhance development of riparian functions and diversify native vegetation types, habitat structure, and seral stage).</p> <p>The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be</p>	<p>SOBB1.2 SUTH1.1 SUTH1.2</p> <p>VRNC1.1 VRNC2.3 RIBR1.1 RIWR1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			decreased if causal relationships between restoration actions and outcomes are established.	
<i>Monitoring Action CM7-2. Document the extent of covered species habitat supported by restored riparian natural communities.</i>				
<p>Base Condition: As-built construction drawings.</p> <p>Approach: Evaluate and quantify the extent of each covered species habitat based on evaluation of data collected under Monitoring Action CM7-1.</p> <p>Schedule: Annually quantify the extent of restored, covered species habitats for the first 5 years following the implementation of every riparian restoration project and every 5 years thereafter.</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) including terrestrial data 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (terrestrial botanist/ field personnel) See also Monitoring Action CM4-1, CM4-2, CM16-1, CM16-2) 	<ol style="list-style-type: none"> 1. Acres of each covered species habitat restored. 	<p>This monitoring action is intended to provide information regarding the development of habitat functions for covered species in restored riparian habitats over time. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.</p>	VRNC1.1
<i>Monitoring Action CM7-3. Document the extent of restored riparian brush rabbit and riparian woodrat habitat.</i>				
<p>Base Condition: As built construction drawings.</p> <p>Approach: Annual stratified randomized surveys of Riparian brush rabbit for 10 consecutive days</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) including terrestrial data 	<ol style="list-style-type: none"> 1. Acreage and net gain or loss (%) of suitable habitat with adjacent upland flood refugia 2. Number and size of largest patches of suitable riparian habitat with upland refugia 		RIBR1.1 RIWR1.1

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Schedule: Every 5 years in suitable riparian habitat followed by surveys every 5 years</p>	<p>2. field survey crews for riparian wildlife surveys</p>	<p>3. Connectivity between suitable riparian habitat in the Plan Area and occupied habitat outside the Plan Area 5. Presence/abundance of riparian woodrats in Conservation Zone 7 6.</p>		
<p><i>Monitoring Action CM7-4. Document the self-sustainability of restored riparian habitats and their functioning over time.</i></p>				
<p>Base Condition: As-built construction drawings.</p> <p>Approach: Evaluate and quantify the extent of restored riparian habitat exhibiting ecological succession, characteristic attributes and regeneration based on evaluation of data collected under Monitoring Action CM7-1.</p> <p>Schedule: Quantify the extent of restored riparian habitat exhibiting regeneration and/or ecological succession by spatially tracking changes in seral stage every 5 years beginning with the implementation of every riparian restoration project.</p>	<p>Existing Programs: None</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> Habitat structural monitoring/inventory using standard forestry and/or botanical protocols randomized sampling of riparian habitat structure 	<ol style="list-style-type: none"> Percent relative cover of restored riparian habitat exhibiting succession Percent relative cover of restored riparian habitat exhibiting regeneration. Connectivity with existing riparian corridors 	<p>This monitoring action is intended to provide information regarding the self-sustainability of restored riparian habitats and their functioning over time. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.</p>	<p>ECSY6.5 VRNC2.1</p>
<p><i>Monitoring Action CM7-5. Determine covered wildlife species use of restored riparian habitats.</i></p>				
<p>Base Condition: The existing distribution and abundance of covered wildlife species in restored riparian patches based on existing information and</p>	<p>Existing Programs:</p> <ol style="list-style-type: none"> Breeding bird survey routes (partial) historical and intermittent research results (e.g., Point Reyes Bird Observatory bird 	<ol style="list-style-type: none"> Estimated abundance of each species using restored riparian habitat Estimated extent of 	<p>This monitoring action is intended to provide information regarding the type and extent of use of restored habitats by riparian-associated covered</p>	<p>VRNC1.1 VRNC2.1 RIBR1.1 RIWR1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>additional surveys if/where needed.</p> <p>Approach: Conduct standardized surveys using established methods to determine the abundance and type of use (e.g., foraging, nesting) of riparian habitats by covered wildlife species.</p> <p>Schedule: Conduct surveys for each species during each species' active period for 5 years following the implementation of each restoration project as determined through data collected under CM4-2 and every 5 years thereafter.</p>	<p>monitoring database from over 250 sites in riparian habitats throughout California, much of it in the Central Valley)</p> <p>3. CALFED science program bird monitoring element of project plans</p> <p>Potential Program Additions:</p> <p>1. Breeding bird surveys (USGS protocol) at additional locations in restored riparian habitats, surveys should be consistent with the Riparian Habitat Joint Venture's "Riparian Bird Conservation Plan"</p> <p>2. Randomized amphibian and reptile surveys during peak activity times in restored riparian habitats and adjacent remnant riparian habitats (control sites).</p>	<p>occupied covered species habitat</p>	<p>wildlife species.</p> <p>This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species.</p> <p>The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.</p>	
CM8: Restore Grassland Communities				
<i>Monitoring Action CM8-1. Document the extent of grassland habitat restored.</i>				
<p>Base Condition: As-built construction drawings.</p> <p>Approach: Delineate the extent of grassland habitat by vegetation type, vegetation structure, and dominant species composition.</p> <p>Schedule: Annually delineate habitat components for the first 5 years following the implementation of individual grassland restoration projects.</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions:</p> <p>1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) including terrestrial data</p> <p>2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (terrestrial botanist/ field personnel) See also Monitoring Action CM4-1, CM4-2, CM16-1, CM16-2)</p>	<p>1. Acres of each component of restored grassland habitat.</p> <p>2. Percent absolute vegetation cover.</p> <p>3. Percent relative cover of native plant species.</p>	<p>This monitoring action is intended to provide information about the development of grassland attributes in restored grassland habitat parcels over time.</p> <p>Monitoring results will be used to determine if subsequent restoration designs should be modified to improve their ecosystem and habitat functions. It will also guide adaptive management actions</p>	<p>ECSY6.3 ECSY6.5 ECSY8.2 GRNC1.2 GRNC2.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			<p>to improve development of desired habitat attributes (e.g., re-seeding, planting of native vegetation, control of non-native vegetation).</p> <p>The monitoring schedule may be adjusted for a particular project in response to monitoring results, especial the rangeland health assessment. The intensity of monitoring for subsequent projects may be decreased if strong causal relationships between restoration actions and grassland community responses are established.</p>	
<i>Monitoring Action CM8-2. Document the ecosystem functions of restored grassland habitat in comparison with site potential.</i>				
<p>Base Condition: Post-restoration conditions determined under CM8-1). Reference sheet for ecological site(s) – to be developed if necessary.</p> <p>Approach: Apply the “Interpreting Indicators of Rangeland Health” protocol to conduct rapid, qualitative assessment of soil/site stability, hydrologic function, and biotic integrity of restored grassland sites against a reference condition (ecological site; see Appendix I-xx, “Interpreting Indicators of Rangeland Health- version 3.0”).</p>	<p>Existing Programs:</p> <ol style="list-style-type: none"> 1. NRCS National Grazing Lands Team, 2. County RCDs 3. NRCS local and regional offices <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. ESD reference sheets for all restored grassland sites 2. Rangeland health assessment capabilities (terrestrial botanist, collaboration with NRCS soil specialists) 	<p>Rangeland health indicators:</p> <ol style="list-style-type: none"> 1. Rills 2. Water Flow Patterns 3. Pedestals and/or Terracettes 4. Bare Ground 5. Gullies 6. Wind Scour or deposition 7. Litter Movement 8. Soil Surface Resistance to Erosion 9. Soil Surface Loss & Degradation 10. Plant Community Composition and Distribution Relative to Infiltration and Runoff 	<p>This monitoring action is intended to provide information about the development of ecosystem functions in restored grassland habitat components over time.</p> <p>This information will provide the basis for addressing whether subsequent restoration designs should be modified to improve their ecosystem and habitat functions. It also will establish if adaptive management actions or interventions are required to halt deteriorative processes</p>	<p>GRNC1.2 GRNC2.1 GRNC2.2 GRNC2.3 GRNC2.4 GRNC2.5</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Schedule: Conduct rangeland health assessment in year 5 and every 10 years thereafter</p>		<p>11. Compaction 12. Functional/Structural Groups 13. Plant Mortality and Decadence 14. Litter Amount 15. Annual Production 16. Invasive Plants 17. Reproductive Capability of Perennial Plants</p>	<p>(erosion, invasive weeds). Furthermore, the information may provide reasons for additional research studies to address and resolve uncertainties in understanding ecosystem processes in restored grassland habitats.</p> <p>The monitoring schedule may be adjusted for a particular project in response to monitoring results. The intensity of monitoring for subsequent projects may be decreased if strong causal relationships between restoration actions and grassland community responses are established.</p>	
<p><i>Monitoring Action CM8-3. Document the extent of covered species habitat supported by restored grassland natural communities.</i></p>				
<p>Base Condition: Post-restoration conditions determined under CM8-1).</p> <p>Approach: Evaluate and quantify the extent of each covered species habitat based on evaluation of data collected under Monitoring Action CM8-1.</p> <p>Schedule: Annually quantify the extent of restored, covered species habitats for the first 5 years following the implementation of every grassland restoration project</p>	<p>Existing Programs:</p> <ol style="list-style-type: none"> 1. USGS Breeding bird survey routes (partial) 2. historical and intermittent research studies <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Breeding bird surveys (USGS protocol) at additional locations in restored grassland habitats 2. randomized camera trap, track, scat or spotlight surveys for mammals 3. Randomized amphibian and reptile surveys during peak activity times in restored habitats and adjacent remnant riparian habitats 	<ol style="list-style-type: none"> 1. Acres of each covered species habitat restored. 	<p>This monitoring action is intended to provide information regarding the development of habitat functions for covered species in restored grassland habitats over time.</p> <p>This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. The information will also be used to</p>	<p>GRNC1.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
and every 5 years thereafter.	(control sites).		<p>determine what management actions (e.g., prescribed burning, controlled livestock grazing, weed control) are appropriate and indicated to advance progress towards achieving conservation targets.</p> <p>The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if strong causal relationships between restoration actions and outcomes are established.</p>	
<i>Monitoring Action CM8-4: Determine covered wildlife and plant covered species use of restored grassland.</i>				
<p>Base Condition: Post-restoration conditions determined under CM8-1).</p> <p>Approach: Conduct standardized surveys using established methods to determine the abundance and type of use (e.g., foraging, breeding) of vernal pool complex by covered wildlife species.</p> <p>Schedule: Conduct surveys during each species’ active period for 5 years following implementation of each restoration project as determined through data collected under</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions:</p> <p>See CM 8-3</p>	<ol style="list-style-type: none"> 1. Estimated abundance of each species using restored grassland 2. Estimated extent of grassland habitat occupied by each covered species (or number of occurrences for covered plant species) 3. Occurrence of breeding activity 	<p>This monitoring action is intended to provide information regarding the degree of apparent response by covered species to grassland restoration and the habitat functions provided. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species.</p> <p>The monitoring schedule may be adjusted for a particular</p>	GRNC1.2

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>CM8-3 and every 5 years thereafter.</p>			<p>project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established</p>	
<p>CM9: Vernal Pool Complex Restoration</p>				
<p><i>Monitoring Action CM9-1. Document the extent of vernal pool complex restored.</i></p>				
<p>Base Condition: As-built construction drawings.</p> <p>Approach: Delineate the extent of restored vernal pool complex by type (e.g., vernal pools, vernal pool margins, and swales) and in relation to the local moisture gradient and dominant, associated plant communities.</p> <p>Schedule: Annually delineate habitat components for the first 5 years following the implementation of individual vernal pool complex restoration projects and every 5 years thereafter.</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially) Various vernal pool monitoring and sampling plans (e.g.,</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (terrestrial botanist) 	<ol style="list-style-type: none"> 1. Acres of each component of restored vernal pool complex habitat. 2. Percent absolute vegetation cover. 3. Percent relative cover of native plant species. 	<p>This monitoring action is intended to provide information regarding the development of restored habitat components over time.</p> <p>This information will provide the basis for determining if restoration targets (acres) are met, if existing restoration designs and methods are adequate in providing the desired results, and if uncertainties exist that may require additional experimentation or research.</p> <p>Monitoring information will also provide information necessary to determine if habitat management actions are necessary to improve habitat functions (e.g., the need to implementing nonnative species control actions).</p>	<p>VPNC2.1 VPNC2.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			<p>The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.</p>	
<p><i>Monitoring Action CM9-2. Quantify the extent of covered species habitat and functions supported by restored vernal pool complex.</i></p>				
<p>Base Condition: As-built construction drawings.</p> <p>Approach: Evaluate and quantify the extent of each covered species habitat based on evaluation of data collected under Monitoring Action CM9-1 and based on inventory of key environmental correlates or habitat requisites of covered species.</p> <p>Schedule: Annually quantify the extent of restored, covered species habitats for the first 5 years with sufficient hydrology following the implementation of every vernal pool complex restoration project and every 5 years thereafter.</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy 3. Delineation and mapping of species occurrences and special habitat features (key ecological correlates) that are pre-requisite for covered species using the site (e.g., small mammal burrows for burrowing owls) 4. Hydrological monitoring program (remote or on the ground tracking of inundation of vernal pool habitats 5. Survey team for vernal pool species (botanist, aquatic ecologist) 	<ol style="list-style-type: none"> 1. Acres of each covered species habitat restored. 2. Presence and abundance of habitat elements required by covered species for breeding, resting, foraging etc. Source of water feeding the restored vernal pool complex 3. Seasonal timing and duration of the inundation and water-logged soil phase 4. Estimated species diversity 5. Presence/abundance of non-native species 6. Presence/abundance of non-native predators 	<p>This monitoring action is intended to provide information regarding the development of habitat functions for covered species in restored vernal pool complex habitats over time. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species.</p> <p>The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.</p>	<p>VPNC2.1 VPNC2.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<i>Monitoring Action CM9-3: Determine covered wildlife and plant covered species use of restored vernal pool complex.</i>				
<p>Base Condition: The existing distribution and abundance of covered wildlife species in restored vernal pool complex patches based on existing information and additional surveys if/where needed.</p> <p>Approach: Conduct standardized surveys using established methods to determine the abundance and type of use (e.g., foraging, breeding) of vernal pool complex by covered wildlife species.</p> <p>Schedule: Conduct surveys for each species during each species' active period for 5 years for which sufficient hydrology is present following the implementation of each restoration project as determined through data collected under CM9-2 and every 5 years thereafter.</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions: See CM 9-2</p>	<ol style="list-style-type: none"> 1. Estimated abundance of each species using restored vernal pool complex 2. Estimated extent of vernal pool complex habitat occupied by each covered species (or number of occurrences for covered plant species) 3. Occurrence of breeding or regeneration at restored vernal pool complex 	<p>This monitoring action is intended to provide information regarding the degree of apparent response by covered species to vernal pool complex restoration and the habitat functions provided. This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species.</p> <p>The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established</p>	<p>VPNC2.1 VPNC2.2</p>
CM10: Nontidal Freshwater Marsh Restoration				
<i>Monitoring Action CM10-1. Document the extent of nontidal marsh habitat restored.</i>				
<p>Base Condition: As-built construction drawings, comprehensive ecological baseline documentation.</p> <p>Approach: Delineate the extent of nontidal freshwater marsh by</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions: 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab)</p>	<ol style="list-style-type: none"> 1. Acres of each component of restored nontidal marsh habitat. 2. Acres restored or created in Conservation Zones, 1,2,4,5, and 7, respectively) 	<p>This monitoring action is intended to provide information regarding the progress of development of restored habitat components over time.</p> <p>This information will provide</p>	<p>NANC2.1 NWNC2.1 GGSN1.1 GGSN2.1 GGSN2.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>vegetation type, vegetation structure, and plant species composition.</p> <p>Schedule: Annually delineate habitat components for the first 5 years following the implementation of individual non-tidal marsh restoration projects and every 5 years thereafter.</p>	<p>2. Vegetation sampling (on-the ground) for field verification to increase mapping accuracy (aquatic botanist/ field personnel)</p> <p>See Monitoring Action CM4-2, CM16-1</p>	<p>2. Percent absolute upland, emergent and floating vegetation cover.</p> <p>3. Percent relative cover of native plant species.</p>	<p>the basis for determining if future nontidal freshwater marsh restoration projects should be modified to improve ecosystem and habitat functions. It will also identify potential needs for management actions, such as hydroperiod modifications, non-native species control and vegetation management (controlled livestock grazing, prescribed burning).</p> <p>The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.</p>	
<p><i>Monitoring Action CM10-2. Document the extent, attributes and functions of giant garter snake and other covered species habitat supported by restored non-tidal marsh communities.</i></p>				
<p>Base Condition: Baseline documentation, as-build construction drawings and maps</p> <p>Approach: Evaluate and quantify the extent of giant garter snake and other covered species habitats based on evaluation of data collected under Monitoring Action CM10-1 and from field</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions:</p> <p>1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab)</p> <p>2. Vegetation sampling (on-the ground) for field verification to increase mapping</p>	<p>1. Acres of each covered species habitat restored.</p> <p>2. Extent and dispersion/ connectivity of upland refugia for target covered species such as giant garter snake in areas prone to flooding</p>	<p>This monitoring action is intended to provide information regarding the development of habitat functions for giant garter snake and other covered species over time.</p> <p>This information will provide the basis for determining if there is a need to modify</p>	<p>NANC2.1 NWNC2.1 GGSN1.1 GGSN2.1 GGSN2.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>surveys of specific key environmental correlates and habitat requisites for covered species.</p> <p>Schedule: Annually quantify the extent of restored, covered species habitats for the first 5 years following the implementation of every riparian restoration project and every 5 years thereafter.</p>	<p>accuracy (aquatic botanist/ field personnel; see Monitoring Action CM4-1, CM16-1)</p>	<p>3. habitat attributes and habitat function (e.g., foraging, breeding, resting, etc) for Giant garter snake and western pond turtle.</p>	<p>subsequent restoration designs to improve the development of habitat functions for giant garter snake. The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.</p>	
<p><i>Monitoring Action CM 10-3. Document the functionality and condition of restored nontidal marsh habitats over time.</i></p>				
<p>Base Condition: As-built construction drawings. Comprehensive ecological baseline documentation</p> <p>Approach: Conduct a California Rapid Assessment Method for Wetlands (CRAM, Appendix I-X “California Rapid Assessment Method for Wetlands version 5.0.2”) to (a) evaluate wetland conditions and stressors and determine the need for intensive monitoring; (2) evaluate performance of restored nontidal marsh; and (3) assess progress of restoration relative to ambient conditions, reference conditions, and expected ecological trajectories.</p> <p>Schedule: Conduct a CRAM</p>	<p>Existing Programs: none</p> <p>Potential Program Additions:</p> <p>1. develop CRAM capability either per contract with consultant or by training botanical staff.</p>	<ol style="list-style-type: none"> 1. Buffer and Connectivity Metrics 2. Water Source, Hydroperiod, Hydrologic Connectivity 3. Physical Patch Richness 4. Topographic Complexity 5. Organic Matter Accumulation 6. Biotic Patch Richness 7. Vertical Structure 8. Interspersion and zonation 9. Percent Invasive Plant Species 10. Native Plant Species Richness 	<p>This monitoring action is intended to provide information regarding the functionality, condition and self-sustainability of restored nontidal marsh habitats and their ecological dynamics over time.</p> <p>The use of CRAM for ambient monitoring will, over time, help the Implementing Office to quantify the relative influence of anthropogenic stress, management actions, and natural disturbance on the spatial and temporal variability in reference conditions. This information can then be used in the design, management, and assessment of similar wetland projects.</p>	<p>NANC2.1 NANC2.2 NWNC2.1 NWNC2.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>assessment 5 years after project implementation and every 5 years thereafter.</p>			<p>The monitoring schedule may be adjusted for a particular project in response to monitoring results and the intensity of monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established. If the causes are not readily apparent, then research might be recommended to determine the causes and to what extent they can be managed. If the causes are deemed natural, then management actions may not be warranted.</p>	
<p><i>Monitoring Action CM10-4. Determine covered wildlife species use of restored non-tidal marsh habitats.</i></p>				
<p>Base Condition: The existing distribution and abundance of covered wildlife species, especially giant garter snake, in restored and existing nontidal marsh habitats patches based on existing information and additional surveys if/where needed.</p> <p>Approach: Conduct standardized surveys using established methods to determine the abundance and type of use (e.g., foraging, resting) of giant garter snake; reconnaissance level surveys and incidental records of other</p>	<p>Existing Programs: USGS studies of Giant Garter Snakes at four sites in the Sacramento Valley (1996–2006), USGS Natomas HCP Monitoring.</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Add the USGS Giant Garter Snake monitoring team under the IEP program for routine GGS effectiveness monitoring. Conduct, possibly localized mark-recapture /and radio-telemetry studies to determine habitat use patterns within proposed 1,000-acre giant garter snake conservation lands designed to enhance the Caldoni Marsh/White Slough and the Yolo Basin/Willow Slough giant garter snake populations. 2. Annual wildlife surveys for covered 	<ol style="list-style-type: none"> 1. Estimated abundance of each covered target species in created non-tidal, freshwater perennial emergent wetlands 2. Estimated extent of occupied covered species habitat in each created non-tidal, freshwater perennial emergent wetland 3. Acreage of created nontidal marsh that functions as habitat for the giant garter snake within or adjacent to habitat occupied by the Caldoni Marsh/White Slough and Yolo/Willow Slough 	<p>This monitoring action is intended to provide information regarding the use and functionality of restored habitats for covered species, particularly the giant garter snake.</p> <p>This information will provide the basis for determining if there is a need to modify subsequent restoration designs to improve the development of habitat functions for target covered species. It will also determine if additional research studies are needed to assess the</p>	<p>NANC2.1 NANC2.2 NWNC2.1 NWNC2.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>covered species (primarily tricolored blackbird, western pond turtle) and non-native predators or competitors</p> <p>Schedule: Conduct surveys for each species during each species' active period for 5 years following the implementation of each restoration project as determined through data collected under CM4-2 and every 5 years thereafter.</p>	<p>species.</p>	<p>giant garter snake subpopulations in Conservation Zones 2 and 4</p> <p>3. Connectivity of water conveyance and habitat for giant garter snake</p> <p>4. Acreage of created nontidal marsh that functions as habitat for the tricolored blackbird 4</p> <p>5. Acreage of created nontidal marsh that functions as habitat for the western pond turtle</p> <p>6. Abundance of feral pigs, cats and other non-native predators (non-native centrarchid fish and bullfrog) or competitors (non-native turtles), abundance of nest predators and parasites (brown-headed cowbirds)</p>	<p>contribution of restored non-tidal marsh habitats to the viability of covered species.</p> <p>The monitoring schedule may be adjusted annually for a particular project in response to variable water levels and habitat conditions, marsh maintenance and enhancement activities, grazing or other circumstances that necessitate changes in the sampling schedule and/or protocol. Sampling intensity may take into account garter snake activity (and therefore detectability), unfavorable habitat conditions (i.e., lack of water), maintenance activities, trap theft and/or tampering, or other circumstances. Monitoring for subsequent projects may be decreased if causal relationships between restoration actions and outcomes are established.</p>	
CM11 Enhance and Manage Preserved Natural Communities				
<i>Monitoring Action CM11-1. Document the planning and implementing progress for the development of Site-Specific Management Plans</i>				
<p>Base Condition: N/A</p> <p>Approach: Document completion of site-specific management plans for conservation lands in annual plans</p>	<p>Existing Programs: None</p> <p>Potential Program Additions: Project management database</p>	<p>Management plans</p>	<p>This monitoring action is intended to provide information to assess the progress the Implementing Office is making towards developing long-term guidance for site-specific management of each acquired</p>	

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Schedule: Within 1 year of each conservation land acquisition.</p>			<p>BDCP conservation lands.</p> <p>The information in each management plan will provide the menu of actions to be undertaken and related implementation schedules.</p>	
<p><i>Monitoring Action CM11-2 Quantify covered species habitat availability, function, and suitability of conservation lands</i></p>				
<p>Base Condition: Baseline condition reports, existing conditions (see Chapter 2, <i>Existing Conditions</i> and Appendix 1, <i>Covered Species Accounts</i>).</p> <p>Approach: Inventory key habitat correlates and requisites for each covered species associated with natural communities to determine the extent and suitability of covered species habitat on conservation lands over time (e.g., percent of riparian with suitable structure and vegetation associations to support riparian brush rabbit; percent of agricultural habitat suitable for Swainson’s hawk or greater sandhill crane foraging). Conduct comprehensive field surveys, map extent, and document conditions.</p> <p>Schedule: Conduct complete baseline survey the first year following implementation of Site-Specific Management Plan, then repeat biannually for 10 years,</p>	<p>Existing Programs: DWR IISS section within DWR-DES (potentially)</p> <p>Potential Program Additions:</p> <p>2. Vegetation and habitat sampling (on-the ground) for field verification to increase mapping accuracy (botanist)</p> <p>3. Capabilities to determine habitat quality and presence of key habitat correlates for covered species (terrestrial ecologist)</p> <p>See also CM 7-1, CM 8-1, CM 10-1</p>	<ol style="list-style-type: none"> 1. Extent, distribution, age structure, size structure, canopy structure, vegetation associations, and species composition of each natural community on restoration sites 2. Presence of species-specific requisites (e.g., basking sites, roost and nest trees, foraging sites, burrows, cover) 3. Estimated abundance of suitable habitat for each targeted covered species. 4. occurrences of Suisun Thistle 5. proximity of non-rice agricultural lands to occupied Swainson’s hawk nesting habitat 6. relative cover of native grasses and forbs in Alkali 	<p>This action is intended to provide information on the abundance of suitable habitat and habitat functions that addresses any or all life requisites for each covered species on all BDCP protected lands.</p> <p>The information will provide the basis of tracking specific habitat elements and habitat function throughout the Plan Area that is essential for Covered Species occurrence, including riparian structure and composition, functionality of water conveyance canals and associated wetlands, woodlots, tree and hedge rows, vegetation and winter water depth of created managed wetland, and the proportion of agricultural lands with suitable cover types that meet foraging habitat objectives for agriculture-associated covered species. .</p>	<p>ALNC1.2 ALNC1.4 AWNC2.1 FMNC1.1 FMNC2.1 TANC 2.1 GRNC1.1 GRNC2.2 GRNC2.1 IDSC1.1 NANC2.1 VRNC2.1 VRNC2.2 VRNC2.3 VPNC2.1 MWNC1.2 BMNC1.1 ONSW1.1 SUTH1.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>followed by 5-year interval surveys.</p>		<p>seasonal wetlands and grasslands</p> <p>5. acres of greater sandhill foraging habitat within its winter use area and within 2 miles of known roosting sites in CZ 3,4,5, and/or 6</p> <p>6. Prey abundance for grassland foraging species, especially insects, small mammals</p> <p>7. Extent and severity of detrimental agricultural practices and disturbance from adjacent sites</p> <p>7. extent of seasonal buffers around riparian habitats</p>	<p>This monitoring is subject to modification if acquisition proceeds more slowly than expected and the periodicity can be extended.</p>	
<p><i>Monitoring Action CM11-3. Quantify abundance, locations and distribution of Invasive Plants on conservation lands</i></p>				
<p>Base Condition: Percent cover at the time of acquisition.</p> <p>Approach: Develop survey and control protocols and include in Site-Specific Management Plans. Implement periodic inventory of invasive plant populations on conservation lands. Establish thresholds for control actions and implement before thresholds are reached.</p>	<p>Existing Programs: previous landowner’s knowledge, agricultural agency (RCD, NRCS) weed abatement records</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Non-native invasive species survey protocols and identification skills 2. Weed control team (trained staff, equipment, GPS, etc). 	<ol style="list-style-type: none"> 1. Estimated percent cover of invasive species 2. Location 3. Species 4. Previous control measures 	<p>This Monitoring Action is intended to provide information on the extent of invasive plant infestations on BDCP protected lands, and to establish and implement a process of control of invasive species populations.</p> <p>This information will provide the basis for determining the extent of infestation, control triggers, and longterm monitoring to estimate the</p>	<p>ALNC1.1 AWNC2.1 BMNC2.1 CAGB1.1 CAGB1.2 CALT1.1 CCWF/AD EP1.1 CFTR1.1 CFTR1.2 CFTR1.3 DEBC1.1 DEBC1.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Schedule: Conduct complete baseline survey the first year following implementation of the Site-Specific Management Plan; continue in 5-year intervals. Implement control actions as needed based on management thresholds.</p>			<p>success of control actions.</p> <p>This monitoring action is subject to modification based on the response of nonnative invasive species to control measures.</p>	<p>ECSY6.5 ECSY7.1 ECSY8.1 GGNS2.2 GGSN1.1 GGSN2.1 GSHC1.1 GRNC2.1 GRNC2.2 HART/BR IT1.1 HART/BR IT1.2 HART/BR IT1.3 HART/BR IT1.4 HEPE1.1 HEPE1.2 IDSC1.1 MFNC1.2 MWNC2.1 NANC2.1 NWNC2.1 ONSW1.1 SOBB1.1 SOBB1.2 RIBR1.1 RIWR1.1 CRLF1.1 SUTH1.1 SUTH1.2 TANC1.1 TANC2.1 TCBB1.1 VPNC2.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<i>Monitoring Action CM11-4. Fund Research</i>				
<p>Base Condition: N/A</p> <p>Approach: Provide funding to support the USFWS captive breeding and reintroduction program for Lange’s metalmark butterfly and for implementation of the propagation and out-planting program for Contra Costa wallflower and Antioch Dunes evening primrose; and</p> <p>Schedule: As requested.</p>	<p>Existing Programs:</p> <p>Program Additions</p>	<p>Receipt of funds.</p>	<p>This Monitoring Action is intended to assist with established and ongoing research programs to benefit target species.</p> <p>This monitoring action is subject to modification based on continuing research activities and the need for additional funding.</p>	<p>VRNC2.1</p> <p>IDSC1.1</p>
<i>Monitoring Action CM11-5. Increase habitat function for covered species</i>				
<p>Base Condition: Pre-acquisition condition.</p> <p>Approach: Each Site-Specific Management Plan will include specific enhancement objectives to increase habitat function by supporting or increasing specific key environmental correlates and habitat requisites for covered species depending on the location, existing habitat function, and opportunities for enhancement. For example, in grassland habitats where burrowing animals are determined to be limited based on results from implementation of Monitoring Action CM11.3, actions will be undertaken (e.g., manipulation of topography,</p>	<p>Existing Programs: None</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Survey methodology to inventory habitat functions and stressors for individual covered species on conservation land 2. Database on non-native predator records on conservation lands (observations, surveys, control measures) 	<ol style="list-style-type: none"> 1. Burrowing owl occupancy of artificial burrows. 2. Swainson’s hawk and white-tailed occupancy of planted trees. 3. Ground squirrel and rodent activity (burrows per acre). 4. Greater sandhill crane occupancy of created roosts. 5. Activity and reproductive performance of tricolored blackbird colonies. 6. Estimated abundance of California red-legged frogs in enhanced stockponds. 7. Extent of grazing activity in vernal pools 8. Condition of rangeland (cover and composition). 	<p>This action is intended to enhance the function of BDCP protected lands to meet specific covered species requirements.</p> <p>This information will provide the basis for determining the functioning of conservation lands with respect to meeting covered species objectives.</p> <p>Management actions are undertaken based on the guidance in the Site-Specific Monitoring Plan, which is subject to modification based on site-specific conditions, opportunities unforeseen at the onset of implementation, or to adjust to the progress of other</p>	<p>ALNC1.1 ALNC1.1 AWN2.1 BMNC2.1 CAGB1.1 CAGB1.2 CALT1.1 CCWF/AD EP1.1 CFTR1.1 CFTR1.2 CFTR1.3 DEBC1.1 DEBC1.2 ECSY6.5 ECSY7.1 ECSY8.1 GGNS2.2 GGSN1.1 GGSN2.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>reduction in rodent control programs, non-native predator control, etc.) to increase ground squirrel and small mammal populations. Another example is postponing tilling of harvested corn fields to increase available forage for wintering greater sandhill cranes.</p> <p>Schedule: Variable and ongoing.</p>		<p>9. Percent cover of native grasses</p> <p>10. Number of created riparian brush rabbit “bunny mounds”</p> <p>11. Activity , reproductive success and percent of parasitized nests of tricolored blackbird and yellow-breasted chat breeding colonies, and least Bell’s vireo and yellow-billed cuckoo nests.</p> <p>12. Extent of upland refugia in restored marshes.</p> <p>13. Documented predation events at nesting colonies.</p> <p>14. Trend in predator populations.</p> <p>15. Estimated abundance of feral pigs in Suisun Marsh and other conservation lands.</p> <p>16. presence /abundance of black rats in suitable riparian woodrat habitat in Conservation Zone 7</p> <p>17. Acres of each agricultural cover type.</p> <p>18. Forage value of greater sandhill crane winter foraging habitat (lbs per acre).</p> <p>19. Covered aquatic invertebrate occupancy of vernal pools.</p> <p>20. estimated abundance of</p>	<p>site specific management plans and the need to meet overall Plan Area-wide goals.</p>	<p>GSHC1.1 GRNC2.1 GRNC2.2 HART/BR IT1.1 HART/BR IT1.2 HART/BR IT1.3 HART/BR IT1.4 HEPE1.1 HEPE1.2 IDSC1.1 MFNC1.2 MWNC2.1 NANC2.1 NWNC2.1 ONSW1.1 SOBB1.1 SOBB1.2 RIBR1.1 RIWR1.1 CRLF1.1 SUTH1.1 SUTH1.2 TANC1.1 TANC2.1 TCBB1.1 VPNC2.1 VRNC2.1</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
		giant garter snake		
CM12: Methylmercury Management				
<i>Monitoring Action CM12-1: Determine the trend in load of methylmercury or precursors discharged from treated sources</i>				
<p>Base conditions: Mercury concentrations in soils to be restored as tidal habitat before levees are breached based on survey information collected under Conservation Measure CM4, Tidal Habitat Restoration.</p> <p>Approach: Testing of monthly water and sediment samples in restored subtidal habitat areas for methylmercury concentrations.</p> <p>Schedule: Monitor monthly for five years or until relationships between restoration of tidal habitats at different locations in the Plan Area and methylmercury concentrations are understood. After the initial five year monitoring period, every 10 years monitor methylmercury concentrations bimonthly for one year.</p>	<p>Existing:</p> <ol style="list-style-type: none"> 1. Environmental Monitoring program (IEP) 2. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program 3. Continuous Recorder Sites (USBR) 4. Delta Flows network and National Water Quality Assessment Program (USGS) 5. other (DWR, SFEI, etc) 6. UC Davis Biosentinel Hg Monitoring Program <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Establishment and monitoring of methylmercury monitoring stations in restored subtidal habitat areas. See also Monitoring Action CM4-4 and Monitoring Action CM4-6. 2. Expand UC Davis Biosentinel Hg Monitoring Program to include entire Delta and restored floodplain and tidal habitats. 	Concentration of methylmercury and precursors	<p>This monitoring is designed to determine the effectiveness of tidal habitat restoration designs in avoiding or reducing methylmercury concentrations in restored subtidal habitats.</p> <p>This information will be used by the Implementing Office to determine if adjustments in tidal habitat restoration designs are necessary to further reduce methylation of mercury.</p> <p>The monitoring schedule may be adjusted based on assessments of initial monitoring results at each restoration site.</p>	TANC1.1 BMNC1.1 FMNC1.1
<i>Monitoring Action CM12-2: Determine the extent of methylmercury exported into Delta channels.</i>				
<p>Base conditions: 1) Methylmercury concentrations in the water column and sediments in channels adjacent tidal marsh restoration sites before levees are breach based on existing data or</p>	<p>Existing:</p> <ol style="list-style-type: none"> 1. Environmental Monitoring program (IEP) 2. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program 3. Continuous Recorder Sites (USBR) 4. Delta Flows network and National Water Quality Assessment Program (USGS) 	Concentration of methylmercury and precursors	This monitoring is designed to determine the effectiveness of tidal habitat restoration designs in avoiding or reducing export of methylmercury into existing Plan Area tidal aquatic habitats.	TANC1.1 BMNC1.1 FMNC1.1

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>survey data collected for this purpose.</p> <p>2) Methylmercury concentrations in restored subtidal habitats from data collected under CM12-2.</p> <p>Approach: Testing of monthly water and sediment samples in channels adjacent to restored subtidal habitat areas for methylmercury concentrations in conjunction with sampling implemented under CM12-1.</p> <p>Schedule: Monitor monthly for five years or until relationships between restoration of tidal habitats at different locations in the Plan Area and export of methylmercury into adjacent channels are understood. After the initial five year monitoring period, every 10 years monitor methylmercury concentrations bimonthly for one year.</p>	<p>5. other (DWR, SFEI, etc)</p> <p>6. UC Davis Biosentinel Hg Monitoring Program</p> <p>Potential Program Additions:</p> <p>1. Establishment and monitoring of sampling stations in channels adjacent to restored subtidal habitats</p>		<p>This information will be used by the Implementing Office to determine if adjustments in tidal habitat restoration designs are necessary to further reduce methylation of mercury.</p> <p>The monitoring schedule may be adjusted based on assessments of initial monitoring results.</p>	
CM13: Nonnative Aquatic Vegetation Control				
<i>Monitoring Action CM13-1: Detect and document the establishment of non-native submerged (SAV) and floating aquatic vegetation (FAV) in subtidal aquatic habitats in restored tidal habitat areas.</i>				
<p>Base Condition: The current extent of SAV and FAV present in channels adjacent to tidal habitat restoration sites before breaching of levees based on existing information or field surveys.</p> <p>Approach: Monthly monitoring to detect and delineate the extent</p>	<p>Existing Programs: Department of Boating and Waterways is the lead agency for controlling aquatic weeds in the Delta</p> <p>Potential Program Additions:</p> <p>1. SAV/FAV surveys of restored subtidal habitats</p>	<p>Temporal progress of SAV/FAV establishment</p> <p>Spatial extent of SAV/FAV within a restored subtidal habitat project area</p>	<p>This monitoring is designed to determine the SAV/FAV establishment process relative restoration design and parameters related to Plan Area location (e.g., water quality constituents, hydrodynamic conditions, wind patterns). This information will be used</p>	<p>ECSY3.1 TANC1.1 GEFC1.2</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>of SAV and FAV in newly restored tidal habitat areas to detect SAV and FAV establishment, conditions under which it establishes, and patterns of establishment. Monitoring data will be evaluated relative to water quality, hydrodynamic, and other physical parameters collected under other monitoring actions or by others to establish relationships between SAV/FAV establishment and restoration design and site conditions.</p> <p>Schedule: Monitoring will occur for five years at each site until relationships between tidal habitat restoration designs and SAV/FAV establishment are well understood.</p>			<p>to determine if subsequent restoration designs should be adjusted to reduce the likelihood of establishment and extent of SAV/FAV in restored subtidal habitats and to help guide development of more effective SAV/FAV control methods.</p> <p>The duration of monitoring may be increased or decreased as indicated from evaluation of monitoring results.</p>	
<p><i>Monitoring Action CM13-2: Determine the need for implementation of SAV/FAV control actions and the effectiveness of SAV/FAV control actions.</i></p>				
<p>Base condition: the extent and distribution of SAV/FAV in restored subtidal habitat areas before implementation of control actions.</p> <p>Approach: Monthly surveys of restored subtidal habitats from [month] to [month] to assess the extent of SAV/FAV for use in determining need to implement control actions. Weekly surveys to document changes in extent and distribution of SAV/FAV relative to base conditions following</p>	<p>Existing Programs: Department of Boating and Waterways is the lead agency for controlling aquatic weeds in the Delta</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> SAV/FAV surveys of restored subtidal habitats in conjunction with control actions 	<p>Areal extent of SAV/FAV or other appropriate measure (e.g., biovolume)</p> <p>Distribution of SAV/FAV in restored habitat</p>	<p>This monitoring action is designed to provide the information necessary to determine the need to implement control actions, the effectiveness of SAV/FAV control techniques over time, and to help determine the frequency with which control actions will need to be implemented in future years.</p> <p>Monitoring frequency and duration to determine the need to implement control actions</p>	

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
implementation of control actions. Schedule: Monthly surveys to determine the need to implement control actions over the term of BDCP. Monitoring following control actions continues until monitoring indicates that the response of SAV/FAV has stabilized or SAV/FAV is determined to be spreading.			may be adjusted if relationships between SAV/FAV establishment and need for control actions is established.	
<i>Monitoring Action CM13-3: Determine the effectiveness of SAV/FAV control actions in reducing the risk for nonnative predatory fish predation on covered fish species.</i>				
Base condition: Nonnative predatory fish abundance before implementation of control actions as determined through CM15 or surveys conducted specifically for this purpose. Approach: Bimonthly surveys of control areas following control actions to determine the abundance and distribution of non-native predatory fish. Schedule: Monitoring following control actions continues until monitoring indicates that the response of nonnative predatory fish has stabilized or there abundance and distribution increases.	Existing Programs: DFG, USFWS, and NMFS fish monitoring programs Potential Program Additions: 1. Non-predatory surveys of restored subtidal habitats	Number of nonnative predatory fish per unit area	This monitoring action is designed to provide the information necessary to determine the need to implement control actions, the effectiveness of SAV/FAV control techniques over time, and to help determine the frequency with which control actions will need to be implemented in future years.	ECSY3.1 TANC1.1 CHSA1.9 SASP1.5 STEE1.8
<i>Monitoring Action CM13-4: Determine if non-native SAV/FAV control results in measurable increase in turbidity.</i>				
Base condition: Turbidity of the water column at sampling	Existing: 1. Environmental Monitoring program (IEP) 2. National Pollutant Discharge Elimination	Turbidity (NTU, TSS)	This monitoring approach will provide information necessary to determine if removal of	ECSY3.1 TANC1.1 CHSA1.9

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>locations within restored subtidal habitat areas before implementation of SAV/FAV control actions.</p> <p>Approach: Weekly turbidity measurements at sampling sites within restored subtidal habitat areas following implementation of control actions. Conducted in conjunction with monitoring under CM2</p> <p>Schedule: see Monitoring Action CM13-1</p>	<p>System (NPDES) Self Monitoring Program 3. Continuous Recorder Sites (USBR) 4. Delta Flows network and National Water Quality Assessment Program (USGS) 5. other (DWR, SFEI, etc)</p> <p>Potential Program Additions: 1. Establishment sampling stations and monitoring of turbidity in restored subtidal habitat areas</p>		<p>nonnative aquatic vegetation will increase turbidity of the water column to improve habitat conditions for delta smelt.</p>	<p>SASP1.5 STEE1.8</p>
Species-Level Measures				
CM14: Stockton Deep Water Ship Channel Dissolved Oxygen Levels				
<i>Monitoring Action CM14-1 Operate and maintain an oxygen aeration facility in the Stockton Deep Water Ship Channel (DWSC) to increase dissolved oxygen concentrations between Turner Cut and Stockton to meet Total Maximum Daily Load (TMDL) objectives (above 6.0 mg/L from September 1 through November 30 and above 5.0 mg/L at all times).</i>				
<p>Base condition: Existing aeration operations</p> <p>Approach: Keep daily operational and maintenance records for the oxygen aeration facility, tracking hours of operation, amount of Oxygen (lbs) injected, sensor operations and system failures or shutdowns.</p> <p>Schedule: Daily operational logs and maintenance records, DWSC Demonstration Dissolved Oxygen Aeration Facility monthly reports.</p>	<p>Existing Programs: DWR’s Stockton DWSC Demonstration Dissolved Oxygen Project, Bay-Delta Office.</p> <p>Potential Program Additions: None</p>	<p>Operational statistics</p> <ol style="list-style-type: none"> 1. hours of operation 2. lbs of dissolved oxygen 3. failures & shutdowns 4. operational costs 5. maintenance and repair records 	<p>This monitoring activity ensures that the operation of the DWSC dissolved Oxygen aeration facility is recorded accurately and operational data are publicly available.</p> <p>The Implementing Office will use this information to determine if system modifications need to be implemented based on system performance and cost/benefit ratios.</p> <p>The monitoring schedule may</p>	<p>CHSA1.3 GRST1.3 WHST1.3</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			be adjusted if the existing aeration facility will be modified or additional aerators and associated infrastructure are added to optimize DO delivery to the river.	
<i>Monitoring Action CM14-2 Measure levels of dissolved oxygen (DO) delivered to the river within the 7.5 mile low dissolved oxygen area of the ship channel</i>				
<p>Base condition: As built construction drawings</p> <p>Approach: measure dissolved oxygen levels at various distances from the diffuser(s) and depths via remote monitoring stations. Current DO sensors are placed at a depth of about 10 ft (at low tide) and record 15-minute data. Additional sensors will be installed concurrent with addition of diffuser facilities.</p> <p>Schedule: Measure minimum DO levels per 15 min interval at each DO sensor station over a 25 hr tidal cycle. Compile Monthly Dissolved Oxygen Data Reports.</p>	<p>Existing Programs:</p> <p>1. Demonstration Dissolved Oxygen (DO) Aeration Facility remote monitoring stations (NA 40, 42, 43 and 48), handheld instrument data, California Data Exchange Center (CDEC) Rough and Ready Island (RRI) station data, and CDEC San Joaquin River at Garwood Bridge (SJG) station data</p> <p>Potential Program Additions:</p> <p>Possibly additional remote monitoring stations</p> <p>Possible additional diffusers</p>	1. diffused oxygen (mg/L)	Results from this monitoring will be used to assess the performance of the facilities operations at achieving the water quality objective. The BDCP Implementing Office will use this information to determine whether aeration facility operations result in measurable benefits to water quality of the DWSC. Based on review of performance and effectiveness monitoring results, the BDCP Implementing Office will adjust funding levels, oxygen diffuser methods, or other related aspects that will improve the performance and/or biological effectiveness of the project through the BDCP adaptive management process as appropriate. Such changes will be effected through the BDCP adaptive management process and would be included in the subsequent annual work plans.	CHSA1.3 GRST1.3 WHST1.3
<i>Monitoring Action CM14-3 Determine if aeration increases the use of the Stockton DWSC as a migration route for covered fish species.</i>				

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Baseline Condition: existing knowledge and study results on fish migration routes and channel-specific survival rates</p> <p>Approach: Through tracking of marked fish (e.g., acoustic tags, radiotelemetry or other suitable method), determine the proportion of tagged fish that successfully migrate through the DWSC. Determine the residence time within DWSC.</p> <p>Schedule: Implement covered fish species tracking until a precise (+- 5%) estimate of permeability can be established by species, location and season. Once permeability rates have been estimated, fish tracking can be discontinued for 5 years. Every 5 years thereafter, the Implementing Office will estimate permeation rates and residence times for covered fish species for at least 2 months.</p>	<p>Existing Programs: USFWS Delta Juvenile Fish monitoring program (DJFMP), various DFG fish survival and migration tracking studies.</p> <p>Potential Program Additions: Coordinate DJFMP with juvenile fish mortality tracking projects in coordination with operation of DWSC aeration facilities.</p> <p>Separate tracking of tagged adults</p>	<p>Permeation rates (% of tracked fish) Residence time of tracked fish within the DWSC Survival of tagged fish (see also CM 16-3)</p>	<p>This monitoring action is designed to provide information on the effects of DO aeration of the DWSC in enhancing migration of covered species through the DWSC.</p> <p>The Implementing Office will use this information to determine if oxygen diffusion is effective in the re-routing of migrating covered fish species.</p> <p>The monitoring action may be reduced if permeation rates are found to have minimal seasonal and location-dependent variance and are highly precise (+-5%). Results from tracking studies every 5 years will determine if increasing monitoring activities are necessary (i.e., if permeation rates fall below the initially determine value).</p>	<p>CHSA1.3 STEE1.3 GRST1.3 WHST1.3</p>
CM15: Predator Control				
<i>Monitoring Action CM15-1: Document the extent and locations of fish predator hotspots within the Delta.</i>				
<p>Base Condition: Estimated existing locations and types of predator hotspots such as abandoned structures, boats, deep holes, etc. where predators have an above-average effect on sensitive life stages of covered</p>	<p>Existing Programs: Extant knowledge of hotspots by fishery biologists, game wardens and agency staff.: DWR IISS section within DWR-DES (potential data warehouse and GIS repository)</p> <p>Potential Program Additions:</p>	<ol style="list-style-type: none"> 1. Location 2. Size 3. Type 4. Structural elements 5. Abundance and type of predatory fish present and relative threat to covered fish 	<p>This monitoring action is designed to provide information on the location and extent of predator hotspots within Delta waterways.</p> <p>The Implementing Office will</p>	<p>ECSY3.1 CHSA1.9 SASP1.5 STEE1.8</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>fish species, based on existing information.</p> <p>Approach: Using a combination of existing knowledge (e.g., survey of fishermen about striped bass catch locations), aerial surveys (e.g., during mapping of nonnative FAV/SAV), and direct observations (IEP and agency staff on boats within the Delta waterways), inventory and map all known and suspected predator hotspots within Delta waterways where sensitive lifestages of covered fish species are present.</p> <p>Schedule: Within 3 years and prior to implementing any predator control measures at hotspots, conduct complete mapping of all major fish-rearing habitats within each waterway to identify and rank potential hotspots of predators. Continue adding new hotspots as they become known.</p>	<ol style="list-style-type: none"> 1. Development of spatial databases and mapping capabilities including photo-interpretation (GIS lab) 2. tracking of incidental information of predator hotspots from agency staff 	<p>species</p>	<p>use this information to schedule removal/amelioration of structures and channel geometry to reduce favorable spots for predatory fish. It also will allow the Implementing Office to estimate costs and technical constraints in removing certain hotspots and adaptively prioritize these for removal.</p> <p>This information will be updated annually and the scheduling of removal/amelioration activities will be adjusted adaptively based on this information</p> <p>The schedule may be adjusted in response to unscheduled events that add significant hiding cover into the channel (floods, windthrow, etc), and to the removal and decelerating need of removals as the channels are being cleared.</p>	
<p><i>Monitoring Action CM15-2: Document the extent of predator hotspot removals/ameliorations.</i></p>				
<p>Base condition: Completed predator hotspot inventory and map (see CM15-1).</p> <p>Approach: Annually update the database by identifying removed hotspots. Track costs and disposal</p>	<p>Existing Programs: none</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Responsibility to track progress as predator hotspots are removed or ameliorated 	<p>Change in number of hotspots Type of hotspots removed/ ameliorated (abandoned structure, boat, etc.)</p>	<p>See CM 15-1</p>	<p>ECSY3.1 CHSA1.9 SASP1.5 STEE1.8</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>of removed materials.</p> <p>Schedule: Annual.</p>				
<i>Monitoring Action CM15-3: Document the extent of predator removal activities within Delta hotspots</i>				
<p>Base condition: Existing knowledge of agency staff and experts pertaining to predator hotspots (see CM 15-1). Prior to predator control measures, the relative abundance (species, size and age composition) of predatory fish species must be sampled (non-lethally) at least twice per hotspot to establish baseline conditions.</p> <p>Approach: Implement localized predator control actions (e.g., electro-shocking, seining, gill netting or other appropriate methods) to remove targeted predators of covered fish species</p> <p>Schedule: Upon establishing baseline conditions and after implementing control measures, continue localized control measures each year at various locations throughout the Delta. Each hotspot will be treated several times (not more than 10 days apart) until predator numbers removed have declined and show a significant asymptotic trend (leveling off). Resample and retreat hotspots every 3-5 years.</p>	<p>Existing Programs: IEP fish predator control studies</p> <p>Potential Program Additions: Predatory fish control program to reduce localized predator densities and thus reduce covered fish mortality</p>	<p>Predators removed: Species number Size, age Location Diet (gut content)</p>	<p>This monitoring action will provide a estimate of the magnitude of the predator control efforts (Treatment size).</p> <p>This information will be used by the Implementing Office to estimate the effectiveness of controlling predators on sensitive lifestages of covered fish species in open systems (waterways of the delta). It will also provide insight in the life history of predatory fish and will allow addressing potential efficiency issues in an adaptive manner.</p> <p>The Implementing Office will also use these data to address cost effectiveness and to guide additional research,</p> <p>This schedule may be changed upon careful review of results to better encapsulate the response time of predator populations to control measures.</p>	<p>ECSY3.1 CHSA1.9 SASP1.5 STEE1.8</p>
<i>Monitoring Action CM15-4: Determine the survival of covered fish species in response to predator control actions.</i>				

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>Base condition: Baseline studies of predatory fish abundance and mortality levels of covered species due to predation prior to predator control measure implementation.</p> <p>Approach: Implement an adaptive experimental management program using a BACI approach to determine the existence and importance of compensatory predation mortality in sensitive lifestages of covered fish species. Specifically, this program investigates under which environmental conditions mortality of covered fish is additive and hence can be affected by localized predator control. Using a combination of fish tagging, sampling and radio- or acoustic telemetry tracking approaches, the Implementing Office will determine mortality rates due to predators at local predation hotspots in comparison to earlier (unmanaged) circumstances (before) and adjacent, randomly selected non-hotspot sites (control sites)</p> <p>Schedule: Annually, until uncertainty regarding predator management effectiveness (and density dependence) can be reduced and robust correlations between environmental conditions</p>	<p>Existing Programs: USFWS Delta Juvenile Fish monitoring program (DJFMP), Delta smelt mortality monitoring, DFG hatchery fish radio tracking and acoustic tagging studies.</p> <p>Potential Program Additions: Coordinate DJFMP with fish mortality tracking projects in coordination with predator removal projects.</p>	<p>1. Survival rates of sensitive lifestages of covered fish species</p>	<p>This monitoring action is designed to provide information on the effects of predator removals on juvenile fish of covered species.</p> <p>The Implementing Office will use this information to determine if predator removal is effective in increasing the survival of juvenile covered fish species (i.e., mortality is not compensatory / juvenile fish are not regulated by density-dependent factors).</p> <p>To remove uncertainty regarding the role of varying habitat quality and spawning success, the Implementing Office will determine if targeted research or management experiments are needed to determine the conditions under which predator removal an effective management tool to support survival of sensitive lifestages of covered fish species.</p>	<p>ECSY3.1 CHSA1.9 SASP1.5 STEE1.8</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
and predator control effectiveness can be established.				
CM16: Non-Physical Fish Barriers				
<i>Monitoring Action CM16-1 Document the installation of non-physical fish barriers.</i>				
<p>Baseline Condition: As-built construction drawings.</p> <p>Approach: Document the installation and seasonal operation of non-physical fish barriers.</p> <p>Schedule: ongoing as barriers are installed.</p>	<p>Existing Programs: 2009 pilot study (Bowen et al. 2009), various research data.</p> <p>Potential Program Additions: 1. Fish barrier database that tracks seasonal operation, cost and incidental observations</p>	<p>Location Hours and dates of operations Performance/Failures and operational statistics of the three components (light, sound, bubbles) Other incidental observations Cost of operations</p>	<p>This monitoring action will provide information on the operation of non-physical fish barriers.</p> <p>This information will be used by the Implementing Office to schedule operations, redesign failing or faulty equipment, or implement other corrective measures as needed to ensure the continuous operation.</p> <p>The monitoring schedule will be adjusted to reflect additional data needs</p>	<p>CHSA1.4 CHSA1.5 STEE1.3 STEE1.4</p>
<i>Monitoring Action CM16-2: Determine the permeability of non-physical barriers for outmigrating juvenile salmonids.</i>				
<p>Baseline Condition: existing knowledge and study results on fish migration routes and channel-specific survival artes</p> <p>Approach: Through tracking of marked fish (e.g., acoustic tags, radiotelemetry or other suitable method), determine the proportion of tagged fish that penetrate non-physical fish barriers. Determine the residence time at or near barriers.</p> <p>Schedule: Implement juvenile</p>	<p>Existing Programs: USFWS Delta Juvenile Fish monitoring program (DJFMP), DFG hatchery fish radio tracking and acoustic tagging studies.</p> <p>Potential Program Additions: Coordinate DJFMP with fish mortality tracking projects in coordination with operation of non-physical fish barriers.</p>	<p>Permeation rates (% of tracked fish) Residence time of tracked fish within 500 ft of the barriers Lifestage of tracked fish Survival of tagged fish (see also CM16-3)</p>	<p>This monitoring action is designed to provide information on the effects of non-physical fish barriers in deterring juvenile fish of covered species to enter “low survival” channels.</p> <p>The Implementing Office will use this information to determine if non-physical fish barriers are effective in the re-routing of migrating juvenile covered fish species.</p>	<p>CHSA1.4 CHSA1.5 STEE1.3 STEE1.4</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>salmonid tracking prior or at least simultaneously with the initiation of operation of each physical barrier. Continue tracking fish until a precise (+- 5%) estimate of permeability can be established by species, location and season. Use occasional failures as “experiments” to determine “control” values. Once permeability rates have been estimated, fish tracking can be discontinued for 5 years. Every 5 years thereafter, the Implementing Office will randomly select 3 non-physical fish barriers and estimate permeation rates and residence times for outmigrating juvenile salmonids for at least 2 months.</p>			<p>This information will also be used to determine if outmigrating juvenile salmonids “pool” at the barriers. Intermittent replications of fish tracking will ensure that non-physical fish barriers are still functional and effective.</p> <p>The monitoring action may be reduced if permeation rates are found to have minimal seasonal and location-dependent variance and are highly precise (+-5%). Results from tracking studies at 3 randomly selected barriers every 5 years will determine if increasing monitoring activities are necessary (i.e., if permeation rates fall below the initially determined value).</p>	
<p><i>Monitoring Action CM16-3 Determine the abundance of predators and their effect on the survival of outmigrating juvenile salmonids at non-physical fish barriers.</i></p>				
<p>Base condition: Baseline studies of predatory fish abundance and mortality levels of covered species due to predation..</p> <p>Approach: Using a combination of fish tagging, sampling and radio- or acoustic telemetry tracking approaches, or visual sampling (underwater cameras) the Implementing Office will determine the abundance and</p>	<p>Existing Programs: USFWS Delta Juvenile Fish Monitoring Program (DJFMP), DFG hatchery fish radio tracking and acoustic tagging studies.</p> <p>Potential Program Additions: Coordinate DJFMP with fish mortality tracking projects in coordination with operation of non-physical fish barriers.</p>	<p>Survival of tracked juvenile salmonids (a) within 500 feet of non-physical fish barriers, and (b) for the entire migration (by migration route)</p>	<p>This monitoring action is designed to provide information on the effects of non-physical fish barriers in increasing total survival of outmigrating juvenile fish of covered species.</p> <p>The Implementing Office will use this information to determine to what degree survival of migrating juvenile</p>	<p>CHSA1.4 CHSA1.5 CHSA1.9 STEE1.3 STEE1.4 STEE1.8 SASP1.5</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>composition of predator guilds at non-physical fish barriers in comparison to earlier (unmanaged) circumstances (before) and adjacent, randomly selected non-hotspots sites (control sites). In conjunction with CM16-3, estimate predation mortality to juvenile salmonids. Also, investigate if there are correlations between residence time of marked juvenile salmonids and predation risk and survival at barriers.</p> <p>Schedule: Annually, until uncertainty regarding predation rates can be reduced and robust correlations between residence time and survival of marked juvenile salmonids can be established</p>			<p>covered fish species increases as a function of non-physical fish barriers. It will also use these data to determine if predation in the immediate vicinity of barriers increases due to juvenile fish aggregations at the barriers, and to what extent predation at the barriers alters survival during the entire outmigration</p> <p>This information will also be used to determine if predator control activities (see CM15) may be indicated. Results from intermittent replications of fish tracking will determine if non-physical fish barriers are still functional and effective.</p> <p>The monitoring action may be reduced if predation rates are found to have estimable, minimal seasonal and location-dependent variance and are highly precise (+-5%). Results from tracking studies at 3 randomly selected barriers every 5 years will determine if increasing monitoring activities are necessary (i.e., if predation rates increase above the initially determined value).</p>	
<p><i>Monitoring Action CM16-4: Determine change in survivorship of outmigrating juvenile salmonids redirected by non-physical barriers.</i></p>				
<p>Baseline Condition: existing</p>	<p>Existing Programs: USFWS Delta Juvenile</p>	<p>Change in proportion of</p>	<p>This action is designed to</p>	<p>CHSA1.4</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>survivorship of outmigrating salmonids using existing migration pathways Approach: Through tracking of marked fish (e.g., acoustic tags, radiotelemetry or other suitable method), determine change in outmigration success relative to existing conditions Schedule: Annually during peak outmigration periods of affected runs until relationships between barrier operations and outmigration success are understood</p>	<p>Fish monitoring program (DJFMP), DFG hatchery fish radio tracking and acoustic tagging studies. Potential Program Additions: Implementation of targeted studies to assess change in survivorship relative to barrier operations.</p>	<p>outmigrating salmonids passing Chipps Island</p>	<p>provide the Implementing Office with information necessary to determine the effectiveness of non-physical barriers and barrier operations in improving juvenile salmonid survival by directing migration pathways.</p>	<p>CHSA1.5 CHSA1.9 STEE1.3 STEE1.4 STEE1.8 SASP1.5</p>
CM17: Hatchery and Genetic Management Plans				
<i>Monitoring Action CM17-1 Document development and implementation of hatchery and genetic management plans for salmonid stocks.</i>				
<p>Base condition: Existing HGMPs and hatchery operations Approach: BDCP will evaluate progress towards HGMPs for each hatchery through annual accomplishment reports plans, fiscal accounting reports and interagency agreements and work plans. Schedule: within the first 5 years BDCP will have funded and achieved the development of HGMPs for each hatchery within the BDCP area. Updates of</p>	<p>Existing Programs: Existing HGMPs and drafts (Nimbus Hatchery , Feather River Hatchery, Mokelumne River Hatchery) and Coleman National Fish Hatchery and Livingston Stone National Fish Hatchery 2001 Biological Assessment Potential Program Additions: none</p>	<p>Annual fiscal /accounting reports Interagency workplans HGMPs as they are developed</p>	<p>This monitoring action will provide information on the progress the BDCP Implementing Office is making towards the implementation of HGMPs for all salmonid hatcheries affected by BDCP. This information will be used by the Implementing Office to determine if modifications to targets or schedules are necessary, and how modifications will be implemented.</p>	<p>CHSA1.10 STEE1.9</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>HGMPs are conducted every 10 years for the duration of the BDCP.</p>			<p>Such changes will be effected through the BDCP adaptive management process and will be included in the subsequent annual work plans.</p>	
<p><i>Monitoring Action CM17-2 Determine if HGMP development and implementation substantially and cost-effectively benefit covered salmonid stocks.</i></p>				
<p>Base condition: HGMPs as developed and implemented, research hypotheses and models.</p> <p>Approach: With funding from BDCP, the Implementing Office will collaborate in the Design and Evaluation of targeted studies, conducted by collaborating agencies that explicitly test the hypothesis that implemented HGMPs are reducing negative effects on wild Chinook salmon and steelhead.</p> <p>Schedule: 10 years after implementation of the BDCP, the Implementing Office will have completed a comprehensive meta-analysis and evaluation of the HGMP program.</p>	<p>Existing Programs: DFG and USFWS expert staff, UCD genetics lab, hatchery personnel and facilities</p> <p>Potential Program Additions: review and analysis capability (either in house or under contract) to comprehensively and rigorously evaluate studies and data on the impacts of hatchery fish on wild salmonid stocks.</p>	<p>Population viability of wild salmonid stocks Competition indices and models Genetic integrity of hatchery and wild stocks</p>	<p>This monitoring action will provide information on the cost-benefit relationship of implementing HGMPs to benefit wild salmonids.</p> <p>If results of review indicate that HGMP development and implementation does not substantially and cost-effectively benefit covered fish species, the BDCP Management Entity in coordination with Fishery Agencies may terminate this conservation measure. If terminated, remaining funding will be deobligated from this conservation measure and reallocated to augment funding for other more effective conservation measures identified in coordination with the Fishery Agencies through the BDCP adaptive management process.</p> <p>The monitoring schedule may be extended for up to 5 years if longer time series are needed to</p>	<p>CHSA1.10 STEE1.9</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
			determine conclusively the effects of HGMPs on wild salmonid stocks.	
CM18: Illegal Harvest				
<i>Monitoring Action CM18-1: Determine if hiring target of 17 additional game wardens for the BDCP Plan Area has been met</i>				
<p>Base Condition: Current staffing levels of CDFG enforcement officers within the BDCP Plan Area.</p> <p>Approach: Review annual employment reports provided by DFG to determine success in filling vacant game warden positions and to determined why positions were not filled (if applicable)</p> <p>Schedule: Annual monitoring until the 5-year deadline has been met</p>	<p>Existing Programs: none</p> <p>Potential Program Additions:</p> <p>1. Collaborative data exchange with DFG enforcement and Human Resources</p>	<p>1. Hiring of 17 additional game wardens for the BDCP Plan Area</p>	<p>This monitoring action is intended to provide information regarding achieving enhanced enforcement of fishery regulations for covered species.</p> <p>This information will provide the basis for determining if there is a need to modify the hiring process.</p> <p>The monitoring schedule may be extended beyond the initial 5 year period if necessary.</p>	<p>CHSA1.8 STEE1.7 SASP1.3 GRST1.7 WHST1.7</p>
<i>Monitoring Action CM18-2: Determine the game warden’s contact rate with the public</i>				
<p>Base Condition: Current 5-year average contact rate for Game wardens in the BDCP Plan Area</p> <p>Approach: The Implementing Office will review annual reports of enforcement statistics for the BDCP plan area, which details the number of contacts, warnings and citations issued per game warden</p> <p>Schedule: Annual monitoring of game warden contact rates</p>	<p>Existing Programs: Existing analytical methods for assessing effectiveness of contact rates</p> <p>Potential Program Additions:</p> <p>1. Collaborative data exchange with DFG enforcement</p>	<p>1. Rates of contacts, warnings and citations by game warden</p>	<p>This monitoring action is intended to provide information regarding the achievement of enhanced enforcement of fishery regulations for covered species.</p> <p>This information will provide the basis for determining if there is a need provide additional training of game wardens.</p> <p>The monitoring schedule may</p>	<p>CHSA1.8 STEE1.7 SASP1.3 GRST1.7 WHST1.7</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<i>Monitoring Action CM18-3: Determine compliance ratios in routine enforcement activities</i>				
<p>Base Condition: 5-year average compliance ratios for Game wardens in the Bay Delta and similar areas</p> <p>Approach: The total number of contacts with the public and the total number of warnings and citations issued per year will be recorded annually, consistent with current game warden practices.</p> <p>Schedule: Annual monitoring of compliance ratios</p>	<p>Existing Programs: Existing analytical methods for assessing compliance effectiveness</p> <p>Potential Program Additions:</p> <p>1. Collaborative data exchange with DFG enforcement</p>	<p>1. % change in compliance ratios (trend)</p> <p>2. Annual deviation from the 5 year running average compliance ratio.</p>	<p>This monitoring action will provide an assessment of routine enforcement activity and effectiveness of enforcement to reduce illegal harvest</p> <p>This monitoring action will provide the basis for determining if enforcement actions and staffing levels are sufficient to reduce illegal harvest of covered fish in the BDCP Plan Area.</p> <p>The monitoring schedule may be reduced once compliance ratios have declined and are at satisfactory levels</p>	
<i>Monitoring Action CM18-4: Determine success of undercover and non-routine operations</i>				
<p>Base Condition: Current 5-year average arrest ratios for undercover and special enforcement actions in the BDCP Plan Area.</p> <p>Approach: The total number of contacts with the public and the total number of warnings and citations issued per year will be recorded annually, consistent with current game warden practices.</p> <p>Schedule: Annual monitoring of</p>	<p>Existing Programs: Existing analytical methods for assessing success of special enforcement operations</p> <p>Potential Program Additions:</p> <p>1. Collaborative data exchange with DFG enforcement</p>	<p>1. Number of arrests in special undercover enforcement operations</p> <p>2. Annual deviation (% change) from the 3 year running average of number of arrests per person-hour</p>	<p>This monitoring action will provide an assessment of undercover and non-routine enforcement activity and effectiveness of enforcement to reduce illegal harvest.</p> <p>This monitoring action will provide the basis for determining if undercover and special enforcement actions are sufficient to reduce illegal harvest of covered fish in the BDCP Plan Area.</p>	<p>CHSA1.8 STEE1.7 SASP1.3 GRST1.7 WHST1.7</p>

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
compliance ratios			The monitoring schedule may be reduced once arrests/person-hour ratios have declined and are at satisfactory levels.	
CM19: Conservation Hatcheries				
<i>Monitoring Action CM19-1: Support the development of a delta and longfin smelt conservation hatchery by USFWS to house a delta smelt refugial population and provide a source of delta and longfin smelt for supplementation or reintroduction, if deemed necessary by Fishery Agencies.</i>				
<p>Base condition: MOU</p> <p>Approach: IEP will 1) document the establishment of functional hatchery facilities and 2) track the funds expended towards implementing a collaborative development of conservation hatcheries by USFWS through its annual reports, financial and operational records.</p> <p>Schedule: Annually</p>	<p>Resources:</p> <p>1. USFWS proposals</p> <p>Potential Program Additions:</p> <p>1. Conservation hatchery program budget, 2. Conservation hatchery administration staff</p>	1. Annual progress reports	<p>This monitoring action will provide a detailed accounting of expenses and other support provided to USFWS to develop and operate Conservation hatcheries.</p> <p>This information will be used by the Implementing Office to determine if funding levels and expected benefits are within target levels.</p> <p>The annual reporting schedule is maintained for the duration of the conservation hatchery program.</p>	DESM1.6 LOSM1.5
<i>Monitoring Action CM19-2: Support the expansion of the refugial population of delta smelt and establishment of a refugial population of longfin smelt at the University of California, Davis Fish Conservation and Culture Laboratory to serve as a population safeguard in case of a catastrophic event in the wild.</i>				
<p>Base condition: MOU.</p> <p>Approach: IEP will 1) review annual reports to determine if hatchery operations are successful in establishing and maintaining sufficient refugial populations to meet BDCP objectives and 2) track the funds expended towards</p>	<p>Resources:</p> <p>1. University of California, Davis Fish Conservation and Culture Laboratory</p> <p>Potential Program Additions:</p> <p>1. Conservation hatchery program budget 2. Conservation hatchery administration staff</p>	1. Annual progress reports	This monitoring action will provide a detailed accounting of expenses and other support provided to expanding refugial populations of Delta smelt and longfin smelt at the University of California, Davis Fish Conservation and Culture Laboratory.	DESM1.6 LOSM1.5

Table 3-13. Potential Effectiveness Monitoring Actions for Conservation Measures (continued)

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Objectives addressed</i>
<p>expanding refugial population of Delta smelt and longfin smelt at the University of California, Davis Fish Conservation and Culture Laboratory through its annual reports, financial and operational records.</p> <p>Schedule: Annually</p>			<p>This information will be used by the Implementing Office to determine if funding levels and expected benefits are within target levels.</p> <p>The annual reporting schedule is maintained for the duration of the conservation hatchery program.</p>	

[*Note to Reviewers: This table presents in-progress draft potential system-wide monitoring actions based on the five ecological characteristics described in Section 3.6.2, Monitoring Framework. This table will continue to be refined and populated to ensure that all of the system-wide monitoring actions, including incorporation of metrics from the Logic Chain, are addressed.*]

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
Ecosystem Monitoring Element: Foodweb				
Element 1: Primary and Secondary Production				
<i>Monitoring Action SY1-1: Determine the seasonal abundance, distribution, and composition of phytoplankton and zooplankton in Delta and Suisun Marsh/Bay waterways.</i>				
<p>Condition: Seasonal abundances of phytoplankton and zooplankton in Delta and Suisun Marsh channels and waterways as currently sampled.</p> <p>Approach: Establish monitoring stations that are representative of different reaches of the Delta and Suisun marsh. Take monthly grab samples and measurements of chlorophyll a and zooplankton. Invertebrate sampling should be adaptively adjusted to changes in fish diets. Plankton monitoring tracks changes in phyto- and zooplankton diversity, abundance, and distribution associated with physical and other biological factors in the Delta. Salinity and other water quality variables are monitored at all plankton sites.</p> <p>Schedule: Conduct sampling monthly every year for the first</p>	<p>Existing Programs: Ongoing discrete sampling through Environmental Monitoring Program (EMP, under IEP)</p> <p>Potential Program Additions:</p> <p>1. Additional sampling stations to represent the entire system by individual reach or major channel system. Locations of added stations will be fixed during the duration of the plan to detect increase on food availability in delta waterways. Note that additional stations are added under Monitoring Actions CM 4-3, CM4-4, CM4-6, and CM16-5 as levees are breached and sites are flooded to track how food production in individual wetlands develops over time (i.e., flux from wetland restoration sites)</p> <p>Sampling stations will also provide water quality data (e.g.,</p>	<p>1. Phytoplankton: -mg/L chlorophyll a - species composition - relative abundance</p> <p>2. Zooplankton: - number/1,000 m³ - species composition - relative abundance</p> <p>3. variations in oxygen concentration</p> <p>4. organic carbon-14 content</p> <p>5. Stable isotopes of Oxygen (16O, 18O and 17O)</p>	<p>This monitoring action is intended to collect data necessary to determine and quantify the overall production and export of phytoplankton and zooplankton throughout the Delta</p> <p>This information, in combination with evaluation of other project-specific foodweb-related monitoring and research data, will provide the basis for :</p> <p>1. Identifying sources of uncertainty and the design of management experiments and/ research studies, to address uncertainty.</p> <p>2. evaluating underlying conceptual models and hypotheses (source-sink</p>	<p>ECSY2.1 DESM1.2 LOSM1.3 CHSA1.2 CHSA1.4 CHSA1.6 STEE1.2 SASP1.2 GRST1.2 WHST12</p>

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
<p>10 years, then randomly sample 30% of all sampling stations annually for the duration of the BDCP.</p>	<p>temperature, turbidity, pH for ammonia conversion, amount of organic carbon.</p>		<p>dynamics, variability and uncertainty in primary production response)</p> <p>3. evaluating restoration design options to increase the production and export of primary production from restored tidal marsh plains</p> <p>4. Implementing additional management actions to improve production and export of primary production within the Delta.</p> <p>The monitoring schedule will be modified if uncertainty or variances do not support current conceptual models and hypotheses</p>	
<p><i>Monitoring Action SY1-2: Determine the seasonal abundance, distribution, and composition of benthic invertebrates in Delta and Suisun Marsh/Bay waterways.</i></p>				
<p>Base conditions: ongoing benthic monitoring by IEP throughout the Estuary.</p> <p>Approach: Benthic monitoring will be conducted at up to 20 sites within the estuary, with four benthic samples and one sediment sample taken at each site. Samples are analyzed by a</p>	<p>Existing Programs: Benthic monitoring component of IEP’s Environmental Monitoring Program (EMP)</p> <p>Potential Program Additions: Increase the number of benthic sampling stations to up to 20 sites as a representatively sample of the entire BDCP plan area.</p>	<ol style="list-style-type: none"> 1. Species of macro-benthic organisms identified 2. Total number of individuals counted 	<p>This monitoring activity provides information on the benthic communities of the estuary, changes in benthic fauna presence, and abundance and distribution associated physical factors in the estuary. Data collected from the benthic monitoring program is also used to detect newly introduced species in the estuary.</p>	<p>ECSY2.1 DESM1.2 LOSM1.3 CHSA1.2 CHSA1.4 STEE1.2 SASP1.2 GRST1.2 WHST12</p>

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
<p>contracting lab. Samples will be collected using a hydraulic winch and Ponar dredge or other appropriate grab sampler.</p> <p>Schedule: Quarterly</p>			<p>The Implementing Office will use this information to determine the status and change of benthic communities over the term of the BDCP and to evaluate possible causal relationships between physical factors and benthic invertebrate communities.</p> <p>This information will also provide important indicators of invasive species progress, impacts of toxics and water operations, and other changes within the Delta.</p> <p>The implementing office will use this information to address changes and modifications to conservation measures through the adaptive decision making process.</p> <p>The monitoring schedule may be adjusted to provide data at a higher temporal or spatial resolution of deemed necessary.</p>	
Ecosystem Monitoring Element: Physical/Chemical/Nutrient Processes				
Element 2: Water Quality				
<i>Monitoring Action SY2-1: Determine the seasonal and spatial variability of water quality within the Plan Area.</i>				

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
<p>Condition: Existing seasonal water quality conditions based on existing information (see Applicable IEP and other Resources)</p> <p>Approach: Continue current water quality monitoring as mandated by existing D-1641 North and Western Delta agricultural and municipal and industrial (M&I) standards and all water quality requirements contained in the North Delta Water Agency/DWR Contract and other DWR contractual obligations.</p> <p>Schedule: as currently implemented.</p>	<p>Existing Programs:</p> <ol style="list-style-type: none"> 1. Continuous Multiparameter Monitoring, Discrete Physical /Chemical Water Quality Sampling (Environmental Monitoring program; IEP) 2. Continuous Recorder Sites (DWR, USBR) 3. National Pollutant Discharge Elimination System (NPDES) Self Monitoring Program (Central Valley Water Board) 4. Delta Flows Network and USGS)National Water Quality Assessment Program (, Toxic Substances Hydrology Program 5.. other (DWR, SRCSD, SWAMP, Central Valley Water Board, State Water Board, SFEI, etc) <p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. There are over 100 water quality sampling sites within the Delta providing a baseline of water quality data. If needed, additional sampling stations may be added to reflect system-wide representative sampling efforts. Additional water quality sampling stations will be added as levees are breached and sites are flooded to track water quality changes at 	<ol style="list-style-type: none"> 1. Water temperature (°C) 2. mg/L dissolved oxygen 3. NTUs 4. EC 5. pH 6. mg methylmercury/L 7. other nutrients and/or toxicants (e.g., Ammonia, Major Cations (Na, K, Ca, Mg), Metals (Cd, Co, Cu, Fe, Mn, Pb, Zn), inorganic Nitrate, pyrethrins,) 8. Derived location of X2 (isohaline) 	<p>This monitoring action is intended to collect data necessary to determine if salinity conditions are meeting contractual and legal requirements. It also provides data necessary to determine if water quality conditions in the different portions of the Delta remain suitable or improve for supporting covered fish species. This information will also used as a reference condition to determine the possible impact of restoration activities on water quality.</p> <p>This information will be used to address deviations from salinity target conditions, and design modifications and/ research studies to address uncertainty in salinity control.</p> <p>This information will be used to evaluate underlying models and hypotheses of water quality responses conservation measures.</p> <p>This information will aid in identifying sources of uncertainty and will guide the design of further management experiments, design modifications and/</p>	<p>CHSA1.1 CHSA1.6, DESM1.3 GRST1.2 GRST1.4, LOSM1.2 PALA1.1 PALA1.5, RILA1.1 RILA1.5, SASP1.1 STEE1.1 STEE1.5, WHST1.2 WHST1.4</p>

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
	restoration sites. 2. Expand UC Davis Biosentinel Hg Monitoring Program to include entire Delta. see also Monitoring Action CM4-4 and Monitoring Action CM4-6.		research studies to address uncertainty. The monitoring schedule may be adjusted in response to monitoring results to better understand causal relationships between water management and water quality.	
Ecosystem Element 3: Hydrodynamics				
<i>Monitoring action SY 3-1: Determine daily flow characteristics throughout the BDCP Plan area.</i>				
<p>Base Condition: Temporal and spatial patterns of flow throughout the Delta region; DAYFLOW, SI3D predictions.</p> <p>Approach: Continue monitoring Delta flow and hydrological dynamics through IEP’s EMP,. Continue to monitor and calculate flow parameters through Suisun March and at Chipps Island (Delta Net outflow index),</p> <p>Schedule: as currently implemented</p>	<p>Existing Programs:</p> <ol style="list-style-type: none"> Delta Flows network (USGS) (21 continuously operating flow stations) IEP EMP sampling station network (15 sites sampled monthly) Flow models (e.g., DAYFLOW, SI3D) <p>Potential Program Additions: Expand the USGS network to 29 stations as planned</p>	<ol style="list-style-type: none"> Flow (CFS) Salinity (EC) Water temperature (C°) 	This monitoring action will provide data that will be used by water project operators to assess compliance with target flow levels. They provide a framework for understanding how the tidal currents, river inflows, water project exports, temporary barriers, and DCC gate operations impact transport within the upper estuary. These data are also used routinely for numerical model calibration and validation and are regularly leveraged into large interdisciplinary process-based studies.	ECSY1.1 ECSY1.2 ECSY1.3 ECSY1.4 ECSY1.5, ECSY4.1 DESM1.3, DESM1.4 LOSM1.1, LOSM1.2 LOSM1.4, CHSA1.5 CHSA1.6 STEE1.4, GRST1.1, WHST1.1, RILA1.4, PALA1.4
Ecosystem Element 4: Climate Change				
<i>Monitoring action SY 4-1 Determine the long term dynamics of hydrological characteristics (water level, temperature, salinity) throughout the BDCP Plan area.</i>				

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
<p>Base Condition: Current monitoring conducted by the interagency network of recorder stations.</p> <p>Approach: Continue existing continuous USGS and other agency monitoring programs of Bay Delta water levels, salinity and water temperature; continue modeling of</p> <p>Schedule: as currently implemented</p>	<p>Existing Programs: Delta Flows network (USGS) comprised of 21 continuously operating flow stations</p> <p>Potential Program Additions: Expand the network to 29 stations as planned; See Monitoring Action SY4-1</p>	<ol style="list-style-type: none"> 1. Water level (m) 2. Salinity (EC) 3. Water temperature (C°) 	<p>This monitoring action will provide the Implementing Office with information to determine the magnitude and direction of climate-driven environmental change within the Delta. This information will be used to (a) calibrate models and modify hypotheses as necessary, (b) determine if goals, objectives, or conservation measures are no longer linked with underlying models or hypotheses and thus should be adjusted, modified or eliminated, and (c) if and where changes to planned restoration activities should be considered and managed through the adaptive decision making framework.</p>	<p>ECSY1.1 ECSY1.2 ECSY1.3 ECSY1.4 ECSY1.5, ECSY4.1 DESM1.3, DESM1.4 LOSM1.1, LOSM1.2 LOSM1.4, CHSA1.5 CHSA1.6 STEE1.4, STEE1.5 GRST1.1, GRST1.4 WHST1.1, WHST1.4 RILA1.4, RILA1.5 PALA1.4 PALA1.5</p>
Ecosystem Monitoring Element: Ecological Processes				
Element 5: Nonnative Species				
<i>Monitoring Action SY 5-1: Determine the seasonal abundance, distribution, and composition of established nonnative fish predators and competitors with native fishes.</i>				
<p>Base condition: Existing fish surveys and harvest statistics for non-native fish predators/competitors.</p>	<p>Existing Programs: fish surveys</p> <ol style="list-style-type: none"> 1. CDFG 20 mm Survey 2. CDFG Delta smelt larva study 3. USFWS Spring Kodiak Trawl 	<ol style="list-style-type: none"> 1. Abundance, density and diet of non-native predatory centrarchids species (e.g., largemouth bass and sunfishes) in size classes that prey on covered fish species in Delta 	<p>This monitoring action will provide quantitative information about the effectiveness of the conservation measures to reduce predator and competitor</p>	<p>ECSY3.1 TANC1.2 CHSA1.9 STEE1.8 SASP1.5</p>

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
<p>Approach: Annual surveys of non-native fish populations to detect long-term trends. Continue representative sampling of non-native predators in trawls and fish surveys. Estimate harvest rate, population size (CPUE) and age distribution of non-native predatory fish caught in sport fisheries (mark-recapture).</p> <p>Schedule: annual</p>	<p>and 'Supplemental Surveys", (e.g., Mossdale trawl) 4. USFWS Midwater trawl 5. USFWS beach seine 6. CDFG Summer tounet survey 7. UCD/IEP Suisun Marsh otter trawl 8. DFG striped bass mark-recapture program 9. IEP fish predator control studies</p> <p>Potential Program Additions: Expanded sampling location array to create representative systemwide monitoring network of fish populations. Beach seining to reflect micro-habitats and shallow areas not sampled by trawls. Creel surveys or mandatory harvest reporting for non-native sport fish</p>	<p>channels 2. Abundance of non-native predatory fish per unit area of habitat 4. Ratio of non-native fish to native fish 5. Change in harvest success and size of non-native fish caught in sport fisheries</p>	<p>populations for different life stages of covered fish species and their spatial response (presence and density) to these enhancements.</p> <p>Monitoring results will be used to evaluate if targets and objectives have been met, parameterize and evaluate conceptual models and other analytical tools, and to prioritize potential actions according to certainty, magnitude and timeliness of benefit.</p> <p>The information provided will also support decisions on potential modification to conservation measures, goals and objectives. It will also be used to determine if additional research activities or special survey technology should be developed.</p>	
<p><i>Monitoring Action SY 5-2. Determine the abundance and species composition of non-native, submerged and floating aquatic vegetation.</i></p>				
<p>Base Condition: Existing knowledge/surveys/data by resource managers (DBW) will be used to delineate and estimate nonnative SAV and FAV extent in the Delta.</p>	<p>Existing Programs: Department of Boating and Waterways (DBW) Aquatic Pest Control Program (DBW is the lead agency for controlling Water Hyacinth and Egeria in the Delta)</p>	<p>Extent (acres) of nonnative SAV and FAV Maps of the distribution of nonnative SAV and FAV</p>	<p>This monitoring is designed to determine the extent of nonnative SAV and FAV in the waterways and floodplains of the BDCP. The BDCP Implementing Office will use results of plan-area wide</p>	<p>ECSY3.1 TANC1.2 CHSA1.9, SASP1.5, STEE1.8</p>

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
<p>Approach: This monitoring is implemented as a two-stage sampling: 1. determine the extent and locations of SAV/FAV by remote sensing or other appropriate methods; 2. Randomized stratified water column sampling. Once a close correlation has been established between actual vegetation samples and remote sensing, physical vegetation samples can be eliminated from the sampling protocol.</p> <p>Schedule: Every 3 years delineate areas of nonnative invasive aquatic vegetation and conduct Delta wide paired sampling.</p>	<p>Potential Program Additions:</p> <ol style="list-style-type: none"> 1. Collaboration with DBW on delineation and inventory of aquatic weed extent 2. Remote sensing or aerial imagery acquisition multiple times throughout the growing season (additional delineation via GPS/GIS from vessels etc.) 3. Vessel-based subsampling to estimate composition of aquatic species <p>See also Monitoring Actions CM 13-1, SY3.3</p>	<p>Species composition of nonnative aquatic vegetation</p>	<p>monitoring to determine if and where controlling SAV and FAV is achievable and sustainable. This information will be used to determine if non-native aquatic vegetation control measures are sufficient to sustainably reduce their impact in important portions of the Delta. The results will also be used by the Implementing Office to determine if control activities should be adaptively adjusted to changing nonnative SAV/FAV extent. The Implementing Office will also use these results to address uncertainties with research studies and adaptive management experiments.</p> <p>The monitoring schedule may be adjusted to reflect changes in non-native aquatic control efforts.</p>	
<p><i>Monitoring Action SY5-3. Determine the status and distribution of nonnative clams.</i></p>				
<p>Base conditions: ongoing benthic monitoring by IEP throughout the Estuary.</p> <p>Approach: Benthic monitoring will be conducted at up to 20 sites within the estuary, with four benthic samples and one sediment sample taken at each site.</p>	<p>Existing Programs: Benthic monitoring component of IEP’s Environmental Monitoring Program (EMP)</p> <p>Potential Program Additions: Increase the number of benthic sampling stations to up to 20 sites as a representatively sample of</p>	<ol style="list-style-type: none"> 1. Species of non-native bivalves 2. Total number of individuals counted 	<p>This monitoring activity provides information on the non-native clams of the estuary, changes in their presence, abundance and distribution. Data collected from the benthic monitoring program is also used to detect newly introduced species in the estuary.</p>	<p>ECSY3.1 DESM1.1 TANC1.2</p>

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
<p>Samples are analyzed by a contracting lab. Samples will be collected using a hydraulic winch and Ponar dredge or other appropriate grab sampler.</p> <p>Schedule: Quarterly</p>	<p>the entire BDCP plan area.</p> <p>Database to track observation and incidental records of non-native bivalves to estimate their habitat use and range expansion in the Delta</p>		<p>The Implementing Office will use this information to determine the status and change of benthic communities over the term of the BDCP and to evaluate possible causal relationships between physical factors and benthic invertebrate communities.</p> <p>This information will also provide important indicators of invasive species progress, impacts of toxics and water operations, and other changes within the Delta.</p> <p>The implementing office will use this information to address changes and modifications to conservation measures through the adaptive decision making process.</p> <p>The monitoring schedule may be adjusted to provide data at a higher temporal or spatial resolution of deemed necessary.</p>	
<p><i>Monitoring Action SY5-3. Determine the status and distribution of Microcystis blooms.</i></p>				
<p>Base Condition: existing data on Delta microcystis abundance, productivity and correlations with water quality parameters</p> <p>Approach: Establish additional fixed monitoring stations as needed in areas where microcystis</p>	<p>Existing Programs: Environmental Monitoring Program (EMP, under IEP)</p> <p>Potential Program Additions: 1. Locations of added stations will be fixed during the duration of the plan to detect increase on</p>	<ol style="list-style-type: none"> 1. Phytoplankton species composition/relative abundance 2. Phytoplankton density (mg/L chlorophyll a) 3. microcystis colony structure 4. Water temperature 	<p>This monitoring action is intended to collect data necessary to determine and quantify the degree of microcystis spread and toxic blooms in the Delta.</p> <p>This information, in combination with evaluation of other</p>	<p>ECSY3.1 DESM1.3 CHSA1.6 STEE1.5 GRST1.4 WHST1.4 PALA1.5 RILA1.5</p>

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
<p>blooms are observed or likely to occur given water conditions. Take weekly grab samples and measurements of chlorophyll a.</p> <p>Schedule: Conduct sampling for the first 5 years following first detection and every 5 years thereafter.</p>	<p>microcystis abundance and blooming activity in delta waterways Sampling stations will also provide water quality data (e.g., temperature, turbidity, pH for ammonia conversion, amount of organic carbon)</p> <p><i>See Monitoring Actions CM 4-3, CM4-4 , CM4-6, and CM16-5</i></p>	<p>5. NH₄⁺ concentration 6. EC 7. presence of non-native clams (see SY5-3)</p>	<p>foodweb-related monitoring and research data, will provide the basis for :</p> <ol style="list-style-type: none"> 1. Identifying sources of uncertainty and the design of management experiments and/ research studies, to address uncertainty. 2. evaluating underlying conceptual models and hypotheses (e.g., excessive N loading . grazing effects by clams, salinity and temperature limiting factors) 3. evaluating restoration design options to increase the production and export of primary production inundated floodplains 4. Implementing additional management actions to improve production and export of primary production from the floodplain. 	

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
Natural Community Monitoring Element				
Element 6: Landscape change				
Monitoring SY6-1: Determine the long-term changes in the location, extent, distribution and juxtaposition of Natural Communities within the Plan Area.				
<p>Base Condition: Current landscape composition (see Chapter 2, <i>Existing Ecological Conditions</i>).</p> <p>Approach: GIS coverages of natural communities will be updated by remote sensing or other appropriate methods to provide estimates of the change occurring within natural communities and landscapes of the BDCP Planning Area. Classification will be field-checked using BDCP conservation lands as verification sites.</p> <p>Schedule: Every five years</p>	<p>Existing Programs: GIS database (BDCP) Agency databases (CASIL)</p> <p>Potential Program Additions: GIS and spatial analysis capability</p>	<ol style="list-style-type: none"> 1. Extent (acres) 2. Location (boundaries) 3. Distribution (number of parcels, parcel size) 4. Neighborhood spatial statistics 	<p>This monitoring action will provide the Implementing Office with a Planning Area-wide assessment of how landscapes change over time. This provides an important framework for assessing the effectiveness of the conservation lands system and its functionality and role within the overall landscape. It also indicates to what degree landscape change follows anticipated shifts in the distributions of covered species and natural communities in response to climate change.</p> <p>The Implementing Office will use this information to determine if current models and hypotheses on landscape and climate change are supported or need to be modified. It further will use this information to examine the context of conservation measures and to address conservation targets through the adaptive decision making process. For example, if certain natural community types become unexpectedly rare, the</p>	<p>ECSY4.1 ECSY6.2</p>

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
			Implementing Office can adaptively respond by increasing acquisition of conservation lands of the rarest community type. The monitoring schedule may be adjusted if landscape change accelerates.	
Monitoring Action SY6-2: Determine structural connectivity and identify corridors and landscape barriers of the BDCP Plan Area				
<p>Base Condition: Current landscape composition (see Chapter 2, <i>Existing Ecological Conditions</i>).</p> <p>Approach: Connectivity will be evaluated from Planning Area - wide GIS mapping by calculating structural connectivity measures (e.g., mean inter-patch distance and other connectivity measures) and species specific functional connectivity assessments (e.g., least-cost corridor analyses, circuit theory). Connectivity maps will be produced to identify gaps and breaks in structural and functional connectivity throughout the BDCP Planning Area.</p> <p>Schedule: Every 10 years.</p>	<p>Existing Programs: GIS databases (BDCP) Agency databases (CASIL)</p> <p>Potential Program Additions: 1. GIS and spatial analysis capability 2. Connectivity assessment and analysis (including species modeling)</p>	1. Landscape statistics (e.g., contagion, diversity, elevation, area-perimeter ratios)	<p>This monitoring action will provide the Implementing Office with a Planning Area-wide assessment of structural and functional connectivity of habitats for covered species over time. This provides an important framework for assessing the effectiveness of the conservation lands system and its functionality in connecting habitats and improving covered species movement across the landscape.</p> <p>The Implementing Office will use this information to determine the locations where additional conservation land acquisitions are need to increase landscape connectivity.</p> <p>The monitoring schedule may be adjusted if landscape change accelerates or if major, landscape-</p>	ECSY8.1 ECSY8.2

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
			altering events occur (floods, fire, seismic events).	
Element 7: Biodiversity				
<i>Monitoring Action SY7-1: Determine the diversity of native species within the BDCP Area.</i>				
<p>Base Condition: Current species occurrence and predicted habitat (see Appendix 1, Covered Species and Chapter 2, <i>Existing Ecological Conditions</i>).</p> <p>Approach: Calculate the change in the number of present covered species, based on (a) updated maps of natural communities (see Monitoring Action SY6-1), (b) actual surveys of conservation lands, (c) species occurrence databases (e.g., CNDDDB) and other agency records.</p> <p>Schedule: Every 10 years.</p>	<p>Existing Programs:</p> <ol style="list-style-type: none"> 1. GIS databases 2. CNDDDB 	<ol style="list-style-type: none"> 1. Number of species 2. Acres of habitat per species 	<p>This monitoring action will provide information to the Implementing Office whether the presence/occurrence and diversity of covered species may have changed for the Planning Area.</p> <p>The Implementing Office will use this information to evaluate if conservation lands acquisition should be redesigned or modified. It will also use this information to initiate targeted research to determine causal relationships for this change. This monitoring schedule may be intensified to a 5-year interval if rapid change in biodiversity is indicated or following a major, planning area – wide disturbance (flood, seismic event, etc).</p>	ECSY6
Fish, Wildlife, and Plant Monitoring Elements				
Element 8: Abundance and distribution of covered fish species.				
<i>Monitoring Action SY8-1: Determine the distribution and abundance of juvenile salmonid abundance for each run.</i>				
<p>Base Condition: Current knowledge of presence and abundance of juvenile salmonids in Delta waterways</p> <p>Approach: Visual and non-lethal</p>	<p>Existing Programs:</p> <p>Historical sampling, USFWS weekly beach seining survey of juvenile salmonids (49 permanent locations Delta wide)</p>	<ol style="list-style-type: none"> 1. Abundance 2. size 3. race 	<p>This monitoring action will provide information on the presence and abundance and relative use of delta waterways by juvenile salmonids.</p>	<p>CHSA1.4 CHSA1.5 STEE1.3 STEE1.4</p>

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
fish sampling (e.g., beach seining, electrofishing) of representative, randomly selected sections in Delta rearing habitats during the. Schedule: Annually during rearing/outmigration periods of juvenile salmonids, conduct biweekly sampling	Potential Program Additions: 1. Add sampling locations to ensure statistical representative sampling effort See also <i>Monitoring Action CM5-3</i> .	4. location	Results of monitoring will be assessed to determine if salmonid distribution and abundance is responding to increasing habitat and food availability as restoration progresses. The information will be used test and evaluate numerous models and hypotheses on stressors and limiting factors for salmonids in the Delta. The schedule of the monitoring action may be adjusted to reflect changes in management or research results on fish presence in inundated floodplains.	
<i>Monitoring Action SY8-2: Determine the seasonal abundance and distribution of juvenile and adult delta smelt.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	DESM1
<i>Monitoring Action SY8-3: Determine the location of delta smelt spawning habitats.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	DESM1.1
<i>Monitoring Action SY8-4: Determine the seasonal abundance and distribution of juvenile and adult Sacramento splittail.</i>				
Base condition: Conduct surveys of splittail adults, larvae, and eggs to determine the abundance of splittail larvae, juveniles and adult present during the reproductive period. Approach: Conduct fish sampling surveys to determine the change in densities of larvae and juveniles relative to base conditions and in-channel	Existing Programs: USFWS rotary screw traps USFWS beach seine Potential Program Additions: 1. Add sampling locations to include restored floodplain and adjacent channel habitats to ensure statistical representative sampling effort	1. Production of Sacramento splittail (number of larval and early juvenile splittail/10,000 m ³) during floodplain inundation periods	This monitoring action will provide information on productivity of Sacramento splittail populations and the contribution of inundated restored floodplains on spawning and rearing of splittail. This information will be used by the Implementing Office to decide if the production of	SASP1.1 SASP1.3

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
<p>spawning. Schedule: Weekly fish sampling will be conducted in spawning habitat during the first 5 floodplain inundation periods during the splittail spawning season. Subsequently monitor every fifth flood event over the term of the BDCP.</p>			<p>splittail during floodplain inundation periods has increased significantly from base conditions.</p> <p>If monitoring results do not support conceptual models and hypotheses predicting increasing splittail spawning, the Implementing Office will conduct additional studies to determine</p> <ol style="list-style-type: none"> 1. uncertainties and competing hypotheses 2. other factors/stressors that affect splittail spawning and rearing in restored habitats, and 3. restoration design modifications to increase splittail productivity. If causes are related to inundation duration, experimental management of flood control structures and floodplain topography may be used to address uncertainties. <p>The monitoring schedule may be extended or intensified if uncertainties of causal relationships persist.</p>	

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
<i>Monitoring Action SY8-5: Determine the seasonal abundance and distribution of juvenile and adult green sturgeon and white sturgeon.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	GRST1.2 GRST1.3 WHST1.2 WHST1.3
Element 9: Survival of covered fish species.				
<i>Monitoring Action SY9-1: Determine nonnative predatory fish predation rates on each run of juvenile salmonids.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	CHSA1.4 CHSA1.5 CHSA1.9 STEE1.3 STEE1.4 STEE1.8 SASP1.5
<i>Monitoring Action SY8-2: Determine annual outmigration success of juvenile salmonids.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	CHSA1.4 CHSA1.5 CHSA1.9 STEE1.3 STEE1.4 STEE1.8 SASP1.5
<i>Monitoring Action SY8-3: Determine entrainment levels of covered fish species.</i>				
Implemented through Monitoring Actions CM-2 and CM-3.				
<i>Monitoring Action SY8-4: Determine tissue concentrations of selenium, mercury, pyrethroids, and endocrine disrupting compounds in covered fish species.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	[To come.]
<i>Monitoring Action SY8-5: Determine Pacific and river lamprey upstream and downstream migration success.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	[To come.]
Element 10: Growth rates of covered fish species.				
<i>Monitoring Acton SY10-1: Determine the level of co-occurrence of juvenile fall-run Chinook salmon with preferred prey species.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	CHSA1.1
<i>Monitoring Acton SY10-2: Determine the level of co-occurrence of delta smelt with preferred prey species.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	DESM1.2

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
<i>Monitoring Acton SY10-3: Determine the extent of delta smelt rearing habitat.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	DESM1.1
<i>Monitoring Acton SY10-4: Determine the spring abundance of preferred longfin smelt prey species.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	LOSM1.3
<i>Monitoring Acton SY10-5: Determine the seasonal abundance of preferred Sacramento splittail prey items.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	SASP1.2
<i>Monitoring Acton SY10-6: Determine the size (weight, length) distribution of juvenile salmonids of each run outmigrating from the Delta.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	CHSA1.2 STEE1.2
<i>Monitoring Acton SY10-6: Determine the seasonal size (weight, length) distribution of delta smelt and longfin smelt.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	DESM1 LOSM1
Element 11: Production of covered fish species.				
<i>Monitoring Acton SY11-1: Determine the extent of longfin smelt spawning habitat.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	LOSM1.1
<i>Monitoring Acton SY11-2: Determine the upstream migration success of green and white sturgeon through the Delta .</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	GRST1.4 WHST1.4
<i>Monitoring Acton SY11-3: Determine adult recruitment of delta smelt and longfin smelt .</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	DESM1 LOSM1
Element 12: Genetic integrity of wild salmonid stocks.				
<i>Monitoring Action SY12-1: Determine the degree of population genetic variability in each Chinook salmon run and Central Valley steelhead.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	CHSA1.10 STEE1.9
Element 13: Distribution, status, trends of covered wildlife species populations.				
<i>Monitoring Action SY12-1: Determine the number of occupied Swainson’s hawk, least Bell’s vireo, and western yellow-billed cuckoo nesting territories.</i>				
Base Condition: Pre-acquisition condition, existing knowledge on presence of covered species habitat requirements. Approach: Review of agency	Existing Programs: None Potential Program Additions: 1. Database of observation records	1. location 2. species	This action is intended to provide the basis for comparing plan-area-wide species performance to the functioning of conservation lands.	ALNC1.8 ECSY6.5 VRNC1.1 VRNC2.1

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
<p>records, research results, expert knowledge and other data on locations of observations of nesting Swainson’s hawk, least Bell’s vireo, and western yellow-billed cuckoo.</p> <p>Schedule: Annual.</p>	<p><i>See CM 11-5</i></p>		<p>Management actions are undertaken based on the guidance in the Site-Specific Monitoring Plan, which is subject to modification based on site-specific conditions, opportunities unforeseen at the onset of implementation, or to adjust to the progress of other site specific management plans and the need to meet overall Plan Area-wide goals.</p>	
<p><i>Monitoring Action SY12-2: Determine the abundance and distribution of riparian brush rabbit and riparian woodrat if found in the Plan Area.</i></p>				
<p>Base Condition: expert knowledge</p> <p>Approach: track agency records, studies and incidental observations of riparian brush rabbit and riparian woodrat within the BDCP plan Area. If necessary, conduct 10 day trapping grid sampling to verify suspected occurrences.</p> <p>Schedule: Annual compilation of Continue for at least 5 inundation years. Ten repeat every 5 years, focusing on verifying presence in previously established occurrences</p>	<p>Existing Programs: historical surveys, research projects, approved sampling protocols.</p> <p>Potential Program Additions:</p> <p>1. database to track annual information on riparian brush rabbit and riparian woodrat distribution and status</p>	<p>1. Presence and sex/age distribution of riparian brush rabbit and riparian woodrat in the BDCP plan area.</p>	<p>This monitoring action is intended to collect data on the distribution and population trend of riparian brush rabbit and riparian woodrat.</p> <p>Monitoring results will be used to determine if habitat restoration has a source or sink effect on the abundance of riparian brush rabbit and riparian woodrat.</p> <p>This information is necessary to determine if adaptive changes to the implementation schedule or additional measures may be necessary to increase the abundance and viability of of riparian brush rabbit and riparian woodrat populations.</p>	<p>RIBR1.1 RIWR1.1 VRNC1.1 VRNC2.1</p>

Table 3-14. Potential System-Wide Monitoring Actions

Base Conditions, Approach, and Schedule	Applicable IEP and other Programs and Potential Additions to those Programs	Metrics	Adaptive Management Considerations	Biological Goals and Objectives Addressed
<i>Monitoring Action SY12-3: Determine the abundance and distribution of giant garter snake.</i>				
<p>Base Condition: expert knowledge</p> <p>Approach: track agency records, studies and incidental observations of Giant Garter Snakes within the BDCP plan Area. If necessary, conduct field trapping/sampling to verify suspected occurrences.</p> <p>Schedule: Annual compilation of Continue for at least 5 inundation years. Ten repeat every 5 years, focusing on verifying presence in previously established occurrences</p>	<p>Existing Programs: historical surveys, research projects, approved sampling protocols.</p> <p>Potential Program Additions: 1. database to track annual information o Garter snake distribution and status</p> <p><i>See CM 2-16, CM10-4</i></p>	<p>1. Presence and sex/age distribution of Giant Garter Snake</p>	<p>This monitoring action is intended to collect data on the distribution and population trend of giant garter snake.</p> <p>Monitoring results will be used to determine if habitat restoration has a source or sink effect on the abundance of giant garter snakes.</p> <p>This information is necessary to determine if adaptive changes to the implementation schedule or additional measures may be necessary to increase the abundance and viability of giant garter snake populations.</p>	<p>ALNC1.1 ALNC1.2 ALNC1.5 ALNC1.6 TANC1.1 FMNC1.1 FMNC2.1 NANC2.1 NWNC1.1 NWNC2.1 ALNC1.7 ALNC1.8G GSN1.1 GGSN2.1 GGSN2.2</p>
<i>Monitoring Action SY12-4: Determine the abundance of waterfowl wintering in the Plan Area.</i>				
<p>Base Condition: Current waterfowl monitoring as conducted by USFWS, CDFG and CWA</p> <p>Approach: Continue USFWS and CDFG special fall and midwinter aerial surveys. The midwinter survey, the longest running population assessment, focuses on all ducks, geese, swans, and coots.</p>	<p>Existing Programs: USFWS midwinter waterfowl surveys</p> <p>Potential Program Additions: none</p>	<p>1. Number 2. Species 3. sex/age composition (if possible)</p>	<p>This monitoring action provides information on the abundance of wintering waterfowl.</p> <p>The Implementation office will use this information to determine area-wide trends in waterfowl numbers and to compare these with waterfowl use of restored or created wetland wintering habitat for waterfowl.</p> <p>The Monitoring schedule may be</p>	<p>MWNC1.1</p>

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
Schedule: Annual mid-winter surveys as currently implemented by USFWS.			changed if necessary to improve accuracy and/or precision of waterfowl estimates.	
<i>Monitoring Action SY12-5: Determine the abundance of shorebirds using the Plan Area during spring and fall migration periods.</i>				
[Text to come.]	[Text to come.]	[Text to come.]		MWNC1.2
Element 14: Reproductive success of covered wildlife species.				
<i>Monitoring Action SY12-1: Determine Swainson’s hawk, least Bell’s vireo, and western yellow-billed cuckoo the nesting success.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	[To come.]
<i>Monitoring Action SY12-1: Determine the recruitment rate for riparian brush rabbit and riparian woodrat if found in the Plan Area.</i>				
<p>Base Condition: expert knowledge</p> <p>Approach: If riparian brush rabbit or riparian woodrat are verified within the BDCP plan Area, conduct 10day capture-recapture (trapping grid) sampling at the beginning, middle and end of the reproductive period</p> <p>Schedule: 3 consecutive seasons every 10 years .</p>	<p>Existing Programs: historical surveys, research projects, approved sampling protocols.</p> <p>Potential Program Additions:</p> <ol style="list-style-type: none"> trapping survey team, equipment and methodology to conduct capture -recapture 	<ol style="list-style-type: none"> sex/age distribution of riparian brush rabbit and riparian woodrat Lactation rates 	<p>This monitoring action is intended to provide information on recruitment of juvenile riparian woodrats and brush rabbits into the adult population.</p> <p>This information will be used in parameterizing a population viability model for each species. Model output will predict the probability of population persistence and extinction.</p> <p>Monitoring results will be used to determine if habitat restoration has a source or sink effect on the abundance of riparian brush rabbit and riparian woodrat.</p> <p>This information is necessary to determine if adaptive changes to the implementation schedule or</p>	

Table 3-14. Potential System-Wide Monitoring Actions

<i>Base Conditions, Approach, and Schedule</i>	<i>Applicable IEP and other Programs and Potential Additions to those Programs</i>	<i>Metrics</i>	<i>Adaptive Management Considerations</i>	<i>Biological Goals and Objectives Addressed</i>
			additional measures may be necessary to increase the abundance and viability of of riparian brush rabbit and riparian woodrat populations.	
Element 15: Distribution, status, and abundance of covered plant species.				
<i>Monitoring Action SY12-1: Determine the abundance and distribution of intertidal covered plant species.</i>				
[Text to come.]	[Text to come.]	[Text to come.]	[Text to come.]	MFNC1.2 BMNC1.2 FMNC1.2 SUTH1.1 SUTH1.2 SOBB1.1 SOBB1.2